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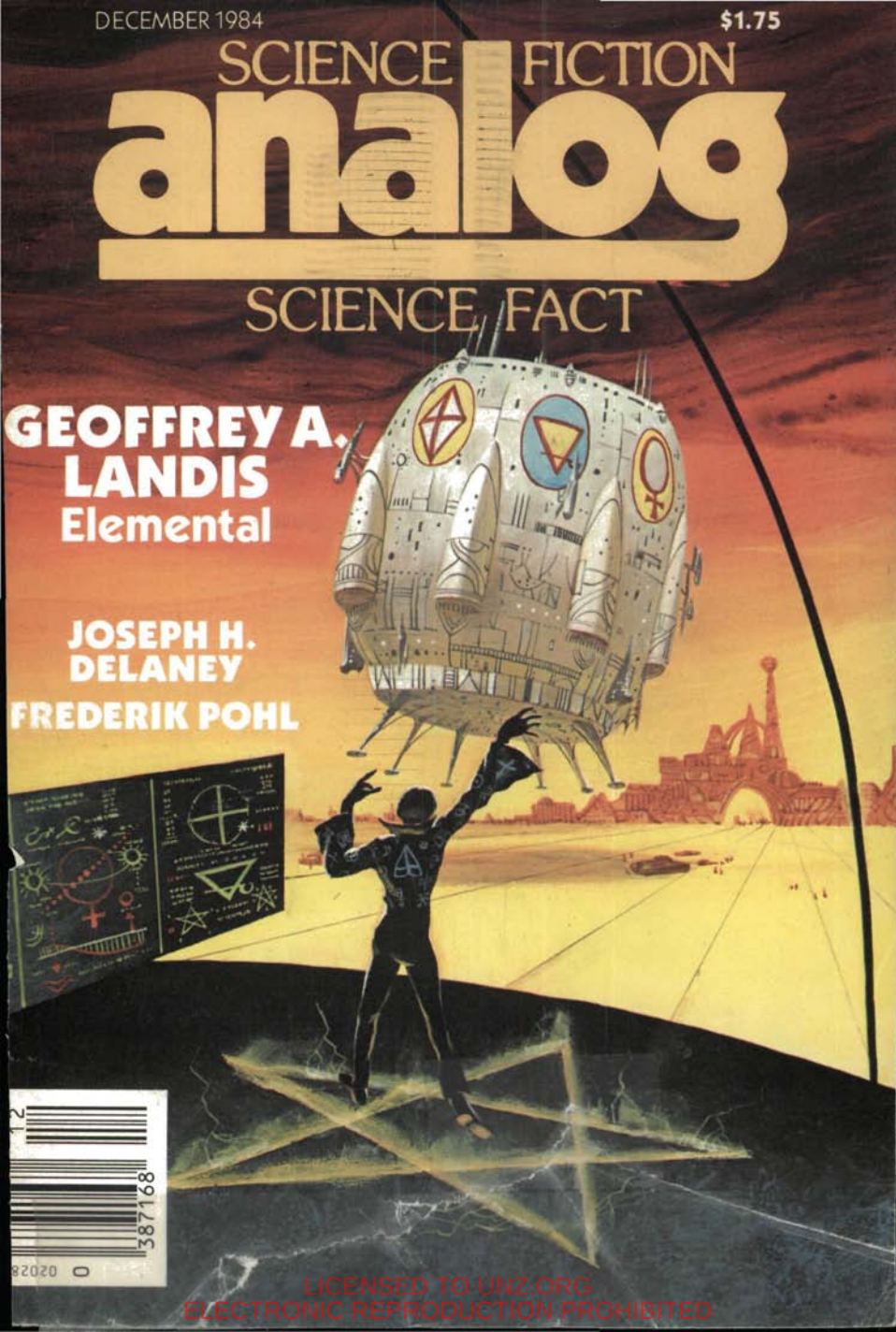

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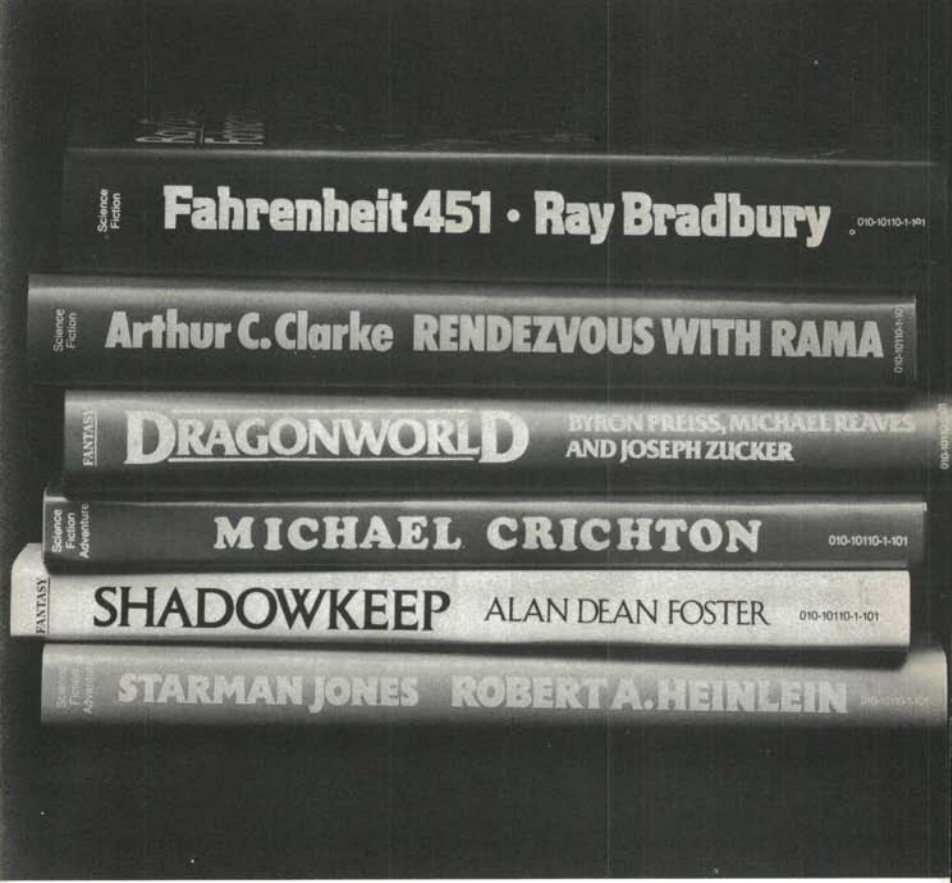

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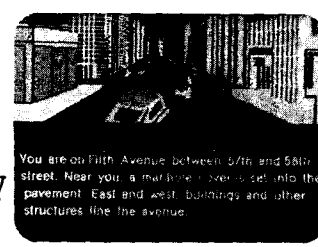
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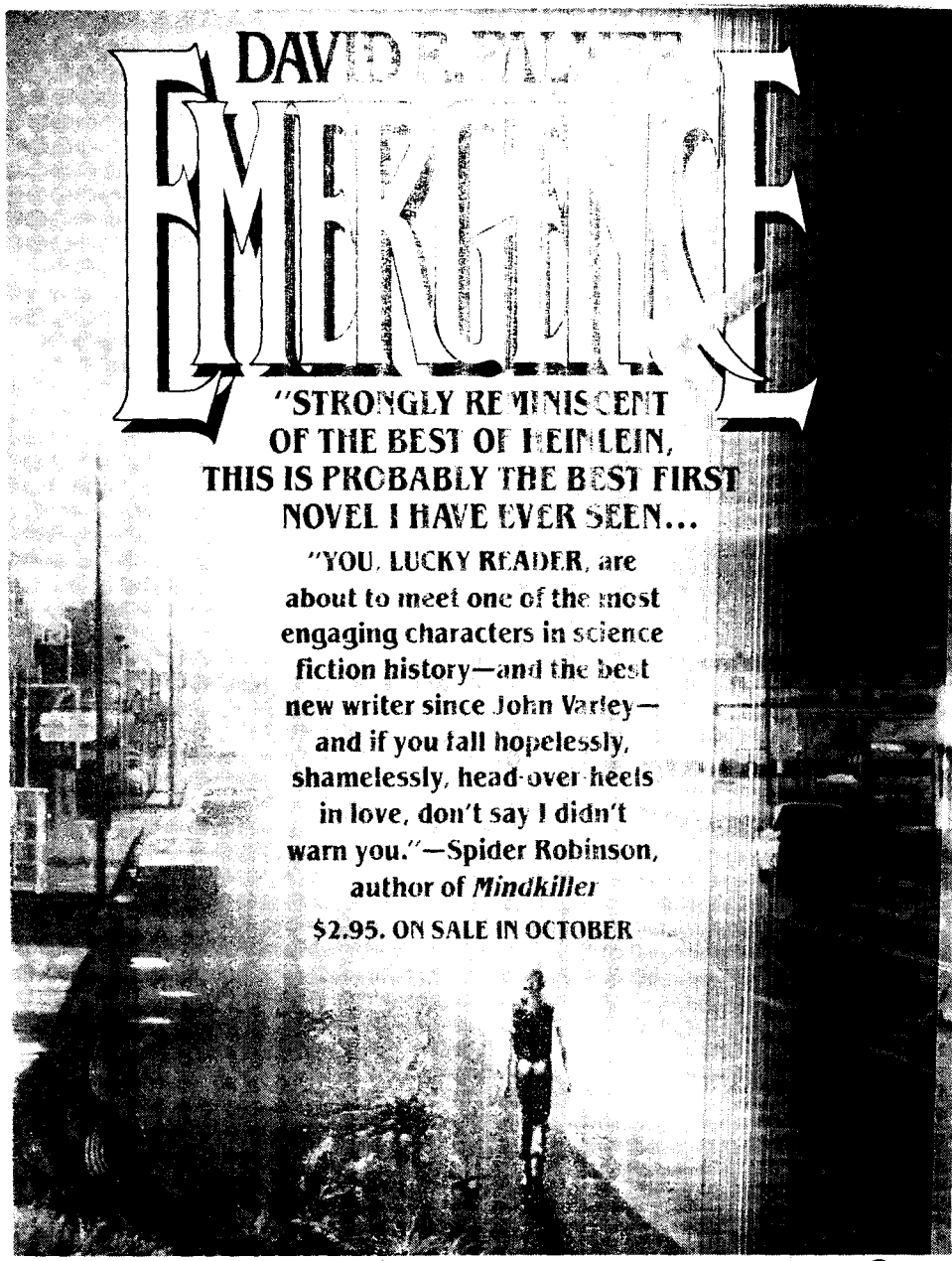
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Vol. CIV, No. 12
December 1984

Next issue on sale
November 6, 1984

$19.50 per year in U.S.A.
$1.75 per copy

Novella

ELEMENTAL, Geoffrey A. Landis ____ 16

Novelettes

Q.E.D., Bruce Stanley Burdick ____ 96
THE SHAMAN, Joseph H. Delaney ____ 148

Science Fact

SECOND PLANET—SECOND EARTH, Stephen L. Gillett, Ph.D. ____ 64

Short Stories

CRITICALITY, Frederik Pohl ____ 82
A VERY GOOD YEAR, Jack C. Haldeman II ____ 120
THE LIFE OF BOSWELL, Jerry Oltion ____ 130

Reader's Departments

THE EDITOR'S PAGE ____ 6
BIOLOG ____ 79
PROBABILITY ZERO, Jay Kay Klein ____ 80
IN TIMES TO COME ____ 94
ON GAMING, Dana Lombardy ____ 95
BRASS TACKS ____ 113
THE ALTERNATE VIEW, G. Harry Stine ____ 126
THE REFERENCE LIBRARY, Tom Easton ____ 143
THE ANALOG CALENDAR OF UPCOMING EVENTS ____ 178

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Analog Science Fiction/Science Fact is published 13 times annually by Davis Publications, Inc. at $1.75 a copy. Jan.—December issues, $2.00, Special Mid-Dec. issue. Annual subscription $19.50 in the U.S.A. and possessions, in all other countries, $24.90 payable in advance in U.S. funds. First copy of new subscription will be mailed within eight weeks of receipt of order. When reporting change of address allow 6 to 8 weeks and give new address as well as the old address as it appears on the last label. Second class postage paid at New York, NY, and at additional mailing office. Canadian 3rd class postage paid at Windsor, Ontario. © 1984 by Davis Publications, Inc. all rights reserved. Protection secured under the Universal Copyright Convention. Reproduction or use of editorial or pictorial content in any manner without express permission is prohibited. All stories in this magazine are fiction. No actual persons are designated by name or character. Any similarity is coincidental. Printed in U.S.A. All submissions must be accompanied by stamped self-addressed envelope; the publisher assumes no responsibility for unsolicited manuscripts or artwork.

POSTMASTER: SEND FORM 3579 to ANALOG SCIENCE FICTION/SCIENCE FACT, P.O. BOX 1936, MARION, OH 43306
IN CANADA RETURN TO 628 MONMOUTH ROAD, WINDSOR, ONTARIO N8Y 3L1
Editorial and Advertising: Analog Science Fiction/Science Fact, 380 Lexington Avenue, New York, NY 10017
Subscriptions: Analog Science Fiction/Science Fact, P.O. Box 1936, Marion, OH 43306 ISSN 0161-2328

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Editorial

GUILTY UNTIL PROVEN INNOCENT

Stanley Schmidt

On returning from a recent trip I had a mildly interesting run-in with The Law—or, more precisely, the security personnel at one of New York City's major airports. Theoretically, these folks are supposed to make sure arriving passengers' claim checks match their luggage tags, but at least until recently this has usually seemed a pretty haphazard thing. Seldom did anybody actually bother, and when a check *was* made it usually seemed casual and perfunctory. On this occasion, though, the guards were quite adamant (and slow) about checking every digit of every number, and quite insensitive to my (true) protests that because of my flight's late arrival, my reservations-only ground transportation was at that very moment about to pull away from the curb and no other would be available for at least an hour and quite likely much longer. I won't say that they became violent in their insistence on a search, but I had the strong impression that they were prepared to.

What I find interesting in all this is

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that I don't think I can expect much sympathy from anybody hearing this story. Chances are you think the guards were completely reasonable in their insistence on "doing their duty" (even though that duty had not been consistently exercised before), and that *I* was unreasonable in asking to be passed right through because of my urgent transportation problem. And that is precisely what concerns me. How have so many of us come to regard as normal and acceptable a manner of conduct so utterly alien to the principles on which we are told our social and political system is based?

You may recall a couple of quaint and charming myths which all children are taught about The American Way: that any person is presumed innocent until proven guilty, and that search and seizure are permitted only upon the issue of a warrant justified by "probable cause." These precepts are not taught as "myths," of course, but as *facts*. Yet the currently prevailing and generally accepted practice at airports, as exemplified by my experience, is completely at odds with these principles. *Everyone* is automatically subject to search on the way to a departure gate, without warrant and with no more probable cause than having bought a ticket. Everyone carrying a suitcase away from baggage claim is presumed guilty of having stolen it until he presents evidence that he has not. I was forced to wait while a slow-witted bureaucrat subjected me to a limited search, not because I was guilty (or even accused) of anything more dastardly than carrying my own suitcase, but simply because *everybody* carrying *any* suitcase is presumed guilty of theft until proven innocent.

And we have been conditioned to regard this as Normal and Acceptable.

Time was when a person minding his own business, with his own property, could reasonably expect to be free of such harassment. A suitcase was assumed to belong to the person carrying it unless somebody else formally contested that claim.

But, you may say, *you* know what New York (and many other places) are like now. Without such routine checks, theft is intolerably common. We *have* to check everybody, even if we'd rather not and even if such practices seem to undermine our most cherished protections.

Yes, I know all about that. But that answer does not justify the offending actions. It merely raises the deeper question of why social conditions have deteriorated to the point where routine searches and presumptions of guilt have come to seem the lesser evil. They don't *have* to be that way. There have been —and still are—cultures and subcultures in which thievery is virtually unknown, where doors can be left unlocked or even wide open and things do *not* disappear.

So why have we come to regard as "normal" the kind of situation we now have in New York? How did it get that way, and how do those other places work?

Those aren't easy questions to answer. Lots of possible causes of increased crime have been suggested, from overcrowding (which seems pretty likely to me) to the elimination of formal

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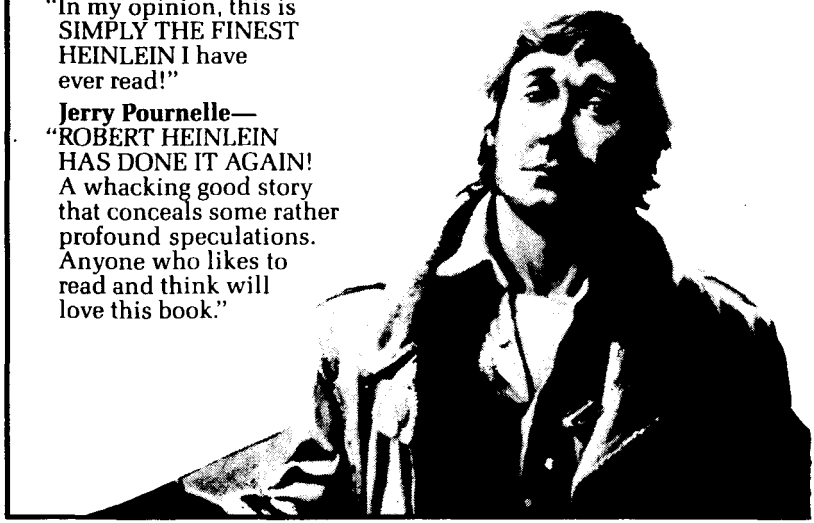

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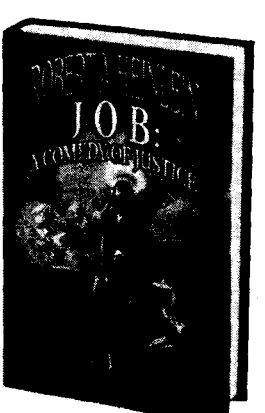

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prayer from public schools (which doesn't). Very little solid evidence, or even testing methodology, has been produced to convincingly evaluate any one of them, or any synergetic combination of them. Another approach might be to look for common denominators in low-crime societies, but that might not be as productive as it sounds. There may be more than one way to produce a given effect (such as low crime), and some of them (such as imposing very harsh punishment for trivial offenses) may have costs we would not be willing to pay.

I will venture one hunch. I recall the substance if not the exact words of a quote I ran across some years ago (attributed, I believe, to Thomas Jefferson) to the effect that, "We need a revolution every nineteen years." Nineteen years, as I understand it, was the speaker's idea of the length of a generation, and the rationale was that political and social systems tend to work best when most of the people living in them have had a personal stake in creating them, really believe they can work, and have a strong personal interest in *making* them work. These conditions are most likely to be met when a system is fairly new—when its citizens remember what it replaced, and remember the blood, sweat, and tears they personally put into establishing something new that they thought could be better. By the time a generation or more has passed, those memories and the original ardor have faded even in the minds of the original revolutionaries. And they have been joined both by their own descendants and by immigrants from elsewhere, who had no part in creating the system they now live under and to whose needs and desires it may be less well suited. Therefore much of

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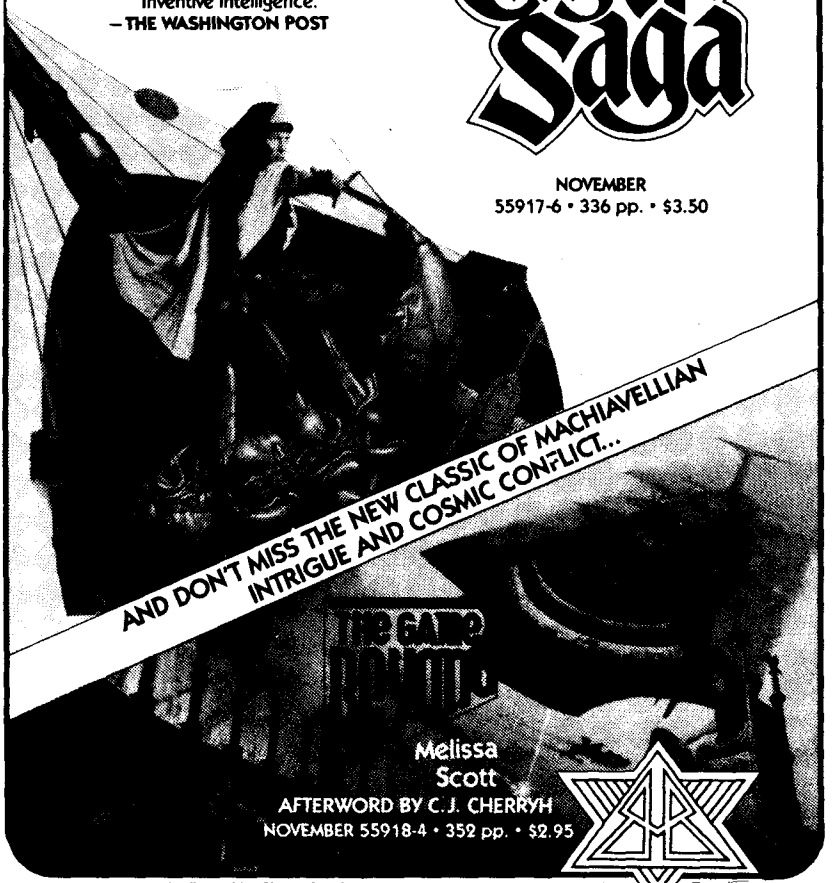

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the original vigor is gone, and cannot be regained unless there is a new "revolution"—not necessarily a bloody war, but *some* means of starting over and consciously crafting a system that the citizens of *now will* see as their own and capable of meeting their needs.

Many of our present problems, I think, result from large numbers of people feeling that they have been dropped into a system which was made by and for other people and does not work for them. Therefore they feel less and less constrained to live by its principles and more and more inclined to find their own ways to serve their own needs—such as taking other people's property when they think they can get away with it. This leads to the need for extraordinary countermeasures—and so begins a destructive cycle of positive feedback, for the more such measures contradict the verbal promises of the existing system, the less people trust that system and the more likely they are to view it as an obstacle rather than a means to their own ends.

So it would seem that we need one of those Jeffersonian revolutions—not, I repeat, a "violent overthrow," but *some* way of giving people the feeling that in some important way they are starting over and building a system of their own that will give *them* a fair shake. One of the intended functions of universal suffrage is to provide a regular mechanism for something like that, but you need look no further than the statistics on how many people vote for evidence that that is not enough. Too many people view the existing electoral system as just one more aspect of the worn-out old system that, at least for them, no longer serves its purpose.

Alternate solutions—ways of restoring the feeling that the individual is actually a functioning part of the system and not merely a passive victim of whatever it chooses to do—seem well worth seeking. Jack C. Haldeman II had one such idea here last year, in his story "We, the People": a tax payment system wherein individual taxpayers stipulated directly how their taxes were to be spent. Dare we hope that checkoff boxes for presidential campaign and wildlife support funds really *are* a beginning toward a workable system like that? Another idea that might be worth trying, in the short run, is one borrowed from the Hugo and Nebula awards: let's add a "NO AWARD" choice to all ballots. Of course, whenever "NO AWARD" or "NONE OF THE ABOVE" wins, somebody's going to have to put some work into finding somebody or something better—but fundamental improvements never come free.

In the longer run, it's been suggested that the development of space colonies might provide a new kind of solution to the problem of societies growing ill-suited to the people living in them. We will *never* have a single form of government or society which satisfies everybody, because people have widely differing tastes and even those of a single individual change with time. Some people are perfectly willing to throw their lot in with all their neighbors in a thoroughly communistic arrangement; others thrive on completely unfettered competition and would much prefer to

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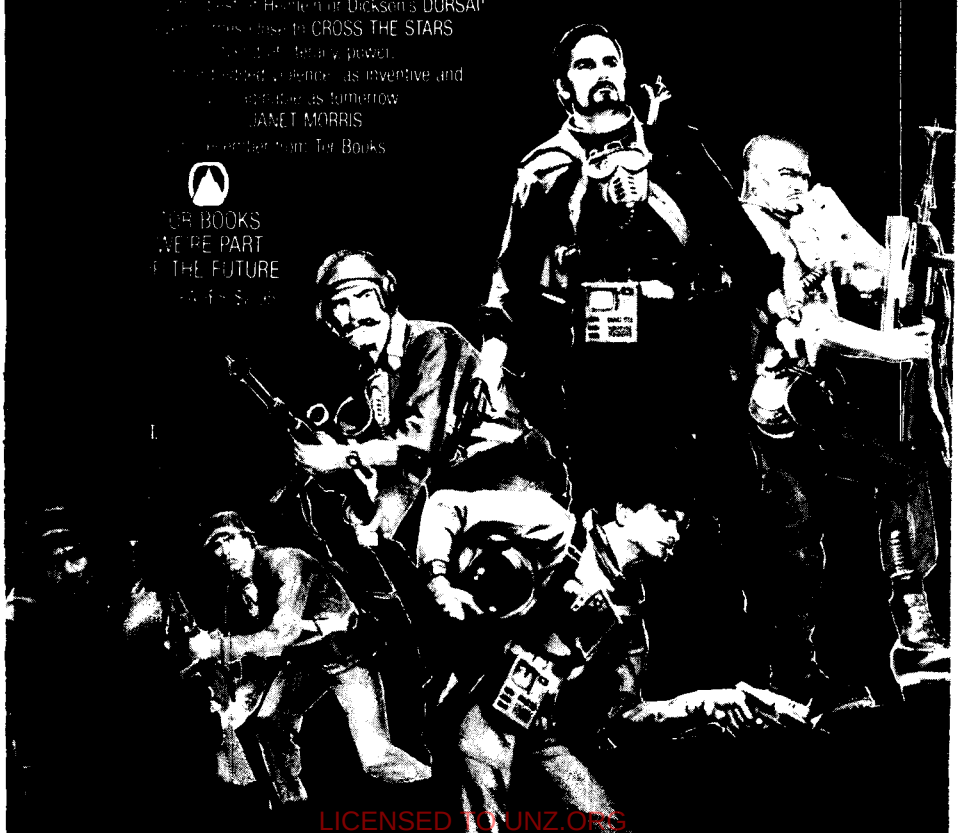

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take their chances with virtual anarchy. In space, it has been suggested, groups of people who prefer any type of social system can get together with others of like mind and set up a chunk of real estate to put it into practice. That way everybody can choose, from a good-sized smorgasbord, a way of life most congenial to him or her.

It sounds lovely, and it could even work—for a while. It worked pretty well here, back when the "New World" was new enough that groups could find their own pieces of frontier to shape in their own images. But, of course, eventually the frontier became a melting pot. It's very well for a group of people who agree on how to live to set themselves apart to do so—but they'll always have to remember and deal with two facts. First, they can't stay isolated indefinitely. To survive and preserve the character of their society, they will have to be able to defend themselves against both overt external invasion and subtler external influences like immigration and commerce. Second, even if they do manage to keep outside influences minimal, they will inevitably change character because of the founders' aging and production of new generations. People born into a colony, no matter how they are raised, will *not* all share the ideas and values of their parents or grandparents. And so the same need for revitalization, through restructuring and rededication, will continue to recur at intervals suspiciously close to nineteen years.

As long as there's lots of new frontier to move to, and lots of opportunity to get there, that can solve the problem. But whenever a society is bottled up for very long, it will have to find other ways. And the more such ways we know, the better off we'll be. ■

● This year may become known as the year of the first man-made planet—the tiny artificial Earth satellite. But to place a man in a multi-stage rocket and project him into the controlling gravitational field of the Moon, where the passenger can make scientific observations, perhaps land alive, and then return to Earth—all that constitutes a wild dream worthy of Jules Verne. I am bold enough to say that such a man-made-Moon-voyage will never occur regardless of all future scientific advances.

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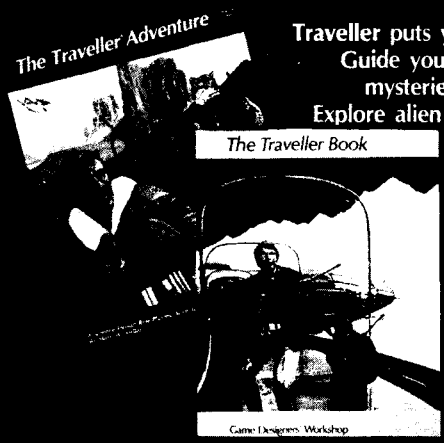

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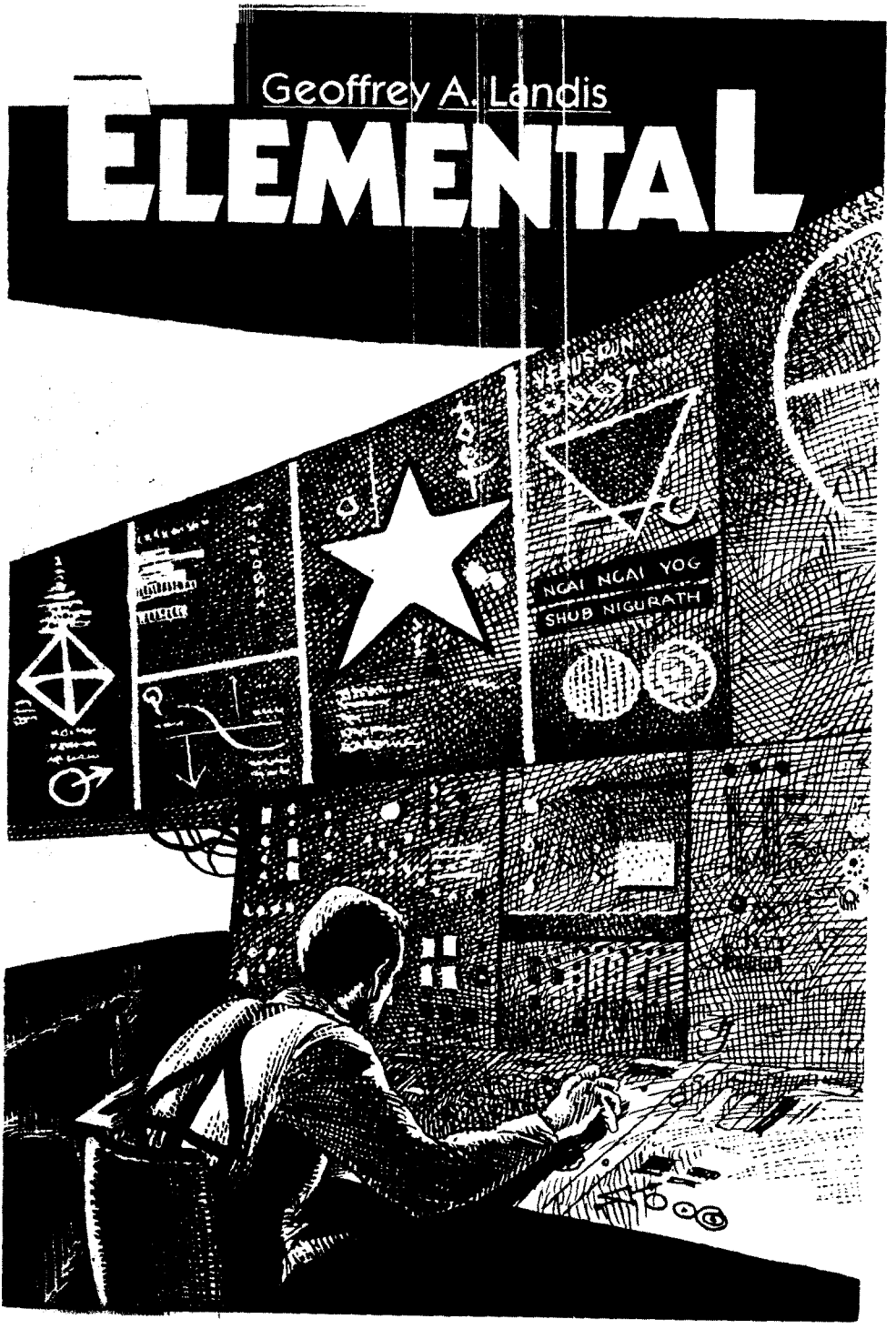

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1. Ramsey

Fifty kilometers southeast of Naples, two men sat waiting in the bright fluorescent-lit power control room of Napoli Spaceport. In front of them glowed an array of green lights and computer consoles. Behind them, outlined on the floor in a violet glow only faintly visible in the brightness of the room, was a complex five-fold symmetric figure: a pentacle.

The younger man watched the array of dials intensely, occasionally touching a knob to make some infinitesimal adjustment. The older man watched him work. What he saw seemed to satisfy him, for he strolled over to the window and gazed out across the landing field.

Without looking up, the younger man spoke: "Luna shuttle's about ready to lift, Mr. Layr."

"Ready for it, Carlo?"

"Running steady at a hundred ten percent, sir."

"She's all yours." Christian Layr walked over to a monitor screen where he could watch the youth's performance and take over if necessary. He doubted that any such necessity would arise. There is a certain skill to controlling magic, a skill of balance and timing not unlike that of a juggler, and the boy had it. Layr almost wished something would go wrong, so he could see how the boy would handle it. The youth had the talent, but Layr would feel uneasy about certifying him until he saw how he tackled a real problem, one of the minor emergencies that make power control a job for men with skill and courage, rather than a simple task for machines. Despite Layr's unspoken wish, though, for the last ten days the station had operated smoothly.

Almost too smoothly.

Layr heard the nearly subsonic rumble of power build-up and directed his attention back to the display. Power level a hundred fifteen percent; there would be no problem with this one.

"Here it goes."

Layr glanced up to the window. As if by magic, the blunt-nosed spacecraft appeared from the launch pit to hover for an instant before his eyes. Slowly it began to inch upward, then to hasten forward with an implacable urgency, finally to rush with a clap of thunder headlong into the morning sky, as if all the demons of hell chased after it.

In a sense, they did. Behind him the control pentagram lit the room with a brilliant violet fire as it transmitted the energy flux to shove the thousand-ton shuttle up to parking orbit. Far beneath his feet, the main pentacle glowed, not violet, but gamma. No human eye could ever look upon it in its full glory. Within the impenetrable walls of the protecting spell was confined a more powerful magic yet: two hundred kilograms of pure antimatter.

In Chicago it was 7 A.M. Yawning, Ramsey Washington looked out the window of his third-floor apartment. A soft wet snow fell steadily. It masked the outlines of the tenements and weighed down the branches of the evergreen that struggled to grow in the building's entrance courtyard. He cursed softly.

Perfect Christmas weather—in April. Some bureaucrat at the weather service must have thought it a good April fool's joke. More likely, he reflected, they'd

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needed a blizzard here as the best way to equalize a water imbalance elsewhere in the world. Africa or Antarctica or Alabama or somewhere. Maybe it had been announced and he'd just missed it.

He dug through the cluttered drawers of his desk and came up with a usable piece of blue chalk and a battered secondhand hardcopy of the *Handbook of Thaumaturgy*, 2052nd edition. He cleared the accumulation of dirty clothes and half-written papers from a one-meter circle on the floor, then carefully chalked a pentacle, copying exactly the diagram in the book. He chanted the book's recommended spell sequence and stepped inside. Spell completed, he grabbed his data microdisc and headed outside.

As he entered the snowstorm, a circle of warm air formed around him. Although by now the snow was nearly twenty centimeters deep over the walk, where he stepped and for a one meter circle around him the snow vanished, reappearing magically behind him again as he walked onward.

Modern thaumaturgy—usually simply called "magic"—was the logical outgrowth of quantum field theory. The basic premise of thaumaturgy is that "reality" is merely an abstract mathematical construct. Therefore, it can be controlled by the manipulation of abstract symbols—provided that the correct symbols can be chosen. The snow ward which Ramsey took for granted was only one of many changes wrought by the consequent technology.

Protected by his home-made ward, Ramsey ignored the snowstorm swirling about him. As he walked under the low-hanging branch of the evergreen in the courtyard he ducked his head instinctively. Anyone as tall as Ramsey quickly learns to duck without ever really noticing it. As he walked under the tree, the snow on the branch above vanished, exorcised by the snow ward. Freed, the branch sprang up, smacking the branch above it and shaking loose a new mound of snow. In a chain reaction of unleashed branches, the whole tree shook itself free of its burden of snow.

Ramsey's low-power spell had been designed to protect against a pretty heavy snowstorm, but it had never been intended to stop an avalanche. The spell overloaded with a loud pop. He abruptly found himself up to his armpits in snow.

Ramsey heard a gigling somewhere behind him, and whirled around to see who was laughing. Unfortunately, the snow was rather more slippery than he'd anticipated. His feet skidded out from under him, and he landed flat on his back in a flurry of snow. Helpless, he heard the giggling rise into a robust laugh.

He pulled himself carefully to his feet. "Have you no respect for the mortally wounded?" He shook himself off and glanced surreptitiously at the girl standing on the sidewalk laughing.

"Oh!" The girl rushed over. "I'm sorry! Are you hurt? Where?"

"My dignity, woman, my dignity's taken a mortal wound. I may never recover."

"Oh, poor baby!" she replied in mock seriousness. "Shall I kiss it and make it better?"

"Hey, that's the best offer I've had all day," said Ramsey. He looked up at the girl and grinned, "Say, you mind if I ask a dumb question? What's your

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name? I've seen you around, but I don't think I know you."

"Susan Robinette," she said. She had just a trace of a French accent. "I work in a lab about two doors down from you."

"Oh! So that's why you seem so familiar! But you're not a physics student, are you? I thought I knew everyone in the department."

"Oh, no; thaumaturgical engineering. My lab just happens to be in the Physics building." She paused. "Say, Ramsey, I apologize for laughing at you. You just couldn't believe the funny look on your face when all that snow started to fall on you."

"Yeah." He thought about it for a second. "Now that you mention it, I guess it was pretty funny. At least in retrospect." He grinned. "Well, if I have to look silly in front of somebody, I guess it's better you than Doctor Williamson." Suddenly he realized he was standing in a snowstorm, and it was cold. He started to shiver.

"Here, come over and share my shield before you freeze to death! Walk with me, and you won't have to make a new shield."

"Yeah, I'd appreciate that. Thanks."

The two of them had to press together in order to fit both into the single snow shield. Ramsey decided he didn't mind at all.

By the time he'd finished breakfast, Ramsey felt more like his usual self. He looked across at Susan. She was nearly as tall as he was, which was surprising right there, and thin. Rather thinner than he usually liked, but pretty in a rather unsophisticated way, with dirty blonde hair and bright brown eyes. He noticed her watching him watch her, and quickly dropped his gaze down to his now-empty plate.

"Well, I gotta run. I got an appointment at nine, and I better not keep Dr. Williamson waiting." He lingered for a moment, trying to think of something else to say. "I'm lucky enough to have her for an advisor; I wouldn't want—"

A booming voice interrupted Ramsey's speech.

"Susie, there you are!" It was a short, rotund man in a dusty tweed jacket. "I've been looking for you. The papers for the Venus project just came in, and we've got to get them turned around. We've got work to do, *liebchen*."

"Professor Kirschmeyer! I'm sorry; I've been dawdling. Do you know—"

"Ramsey Washington. Yes, yes, Janie's protege. Quite the bright young man, she tells me. Maybe even good enough for my young genius here, no?" He winked.

Ramsey started to say something, but Susan beat him to it. "Now, Hans, don't let your dirty mind run away with you. I barely know him, and already you're marrying us off."

Kirschmeyer laughed. "Well!" Turning to Ramsey, he said, "You must excuse us, young man. I must steal your pretty girl away, even if she does claim she doesn't even know you. There is much to do, and too little time." He offered his arm to help Susan up.

"See you around, Ramsey," she said, ignoring Kirschmeyer's offered arm. "Good luck with your meeting."

"Thanks." Kirschmeyer and Susan walked out of the restaurant, already

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deep in conversation. "I'll need all the luck I can get."

In Italy it was early afternoon. The sun beat down warmly, as might be expected on a day in early April. In the fields, two farmers stopped working the rich volcanic soil to rest in the shade of a solar array. One of them brought out the midday snack of bread, wine, and cheese, while the other hooked the tractors up to recharge.

"Explain once more to Giuseppe how it is that your vines produce so bountifully this year."

"It is because of this amulet of my wife's mother." Luca held up a small piece of carved volcanic rock suspended on a silver chain. Giuseppe looked at it dubiously.

"That? It is no different than the one my wife wears about her neck to ward off the evil eye. Yet my vines do not produce like yours."

"Ah," said Luca smugly. "*wearing* is not enough. You must know how to use it."

"Ah," said Giuseppe. "So tell me, how is it done, to use this thing?"

"And why is it I should say to you?"

"Come, Luca. Did we not grow up together? Are we not friends? How is it that you would now hold out on your poor friend Giuseppe?"

"Indeed," said the other. "I would not. This is what is to be done. Each morning before going into the fields you must take the amulet and make with it this gesture—" he demonstrated with his hands "—and say the following chant—" he intoned a short series of nonsense-sounding syllables.

Giuseppe was still dubious. "That's all?"

"Indeed."

"It would be simple enough for me to try. Father Corsi would not approve, though. He would call it witch-work."

"There is no need for Father Corsi to know. Besides, he is surely aware of how many of his flock wear charms against the evil eye, no?"

"Yes. And he calls it idolatry, too."

"But he does not forbid it."

"This is true, he does not. But tell to me, how is it that you know this thing?"

"My cousin Roberto, who was in the navy, learned it from a sailor who had a brother who went to the university to learn science. This sailor knew many things to do with such charms, but only the one of any usefulness."

"So," said Giuseppe. "This does not sound like the devil's work. Indeed, I will do it. Perhaps my vines too will become as bountiful as yours."

"I wish you luck." Luca looked at his wristwatch. "Time now for us both to be back to work." He walked over to his tractor. "Do you remember well the gesture and the words?"

Giuseppe repeated the words, making the gesture Luca had shown. Luca nodded. "Good. I wish you prosperity, my friend."

"And you."

As Giuseppe drove the tractor that afternoon he repeated in his mind the words and the gesture. If it worked he would show it to his brother-in-law, who also grew a small plot of grapes behind his fields. And perhaps to his cousin Rafaelle? Yes, he decided. Such

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a useful thing should not be kept to oneself, but had to be shared with others.

Ramsey looked down at his stack of notes, licked his lips nervously, looked at his watch, and then knocked at the door. Without waiting for a response, he walked confidently in. Doctor Williamson looked up from her desk computer.

"Ah, yes, Mr. Washington. Right on time. I'll be with you in a moment." She turned back to her qwerty.

Ramsey walked over to one of the plush lounge chairs and sat down. He looked at the expensive glass sculpture on the table next to him, then let his eyes wander over to watch her work. What a woman, he thought. She had light brown hair, almost a shade of blonde, cut fashionably short. Today she wore a light green sweater with a gold and green silk scarf wrapped casually around her neck. Dressed in impeccable taste, as always, he thought. I bet she never falls down in the snow on her way in. She flicked the Save switch on the computer and turned to him.

"That outfit looks very good on you, Dr. Williamson," Ramsey remarked casually.

"Thank you, Mr. Washington," she replied curtly. "Now let's get to work, shall we? I presume you've finished the data analysis on your recent run, right?"

"Well, not exactly," Ramsey said. "I've been having a slight problem with the data in the third and fourth quadrants. Nothing important, I'm sure."

"Let's have a look at it." Doctor Williamson reached out a hand. Ramsey quickly dug out his microdisc and gave it to her. She popped it into the receptacle on her computer and studied the screen for a moment.

"I see," she said. "What do you think this signifies?"

"I'm not really sure," Ramsey replied. "Maybe some localized anomaly in the Earth's field?"

"Yes, I suppose that's a possibility. Rather unlikely that no one previously ever mentioned it, though, don't you think? After all, people have mapped the magnetic field for several centuries now."

"Maybe it wasn't there before?"

"Now, that seems rather far-fetched, doesn't it? Just where do you suppose such a change would come from? It looks to me much more like the characteristic signature of a magnetometer that has not been properly degaussed before the measurement."

"I calibrated and degaussed the equipment every two hours," Ramsey said.

"Well, Mr. Washington, it certainly looks here as if you missed one, doesn't it? Don't be too glum about it—if we didn't make mistakes, we wouldn't learn anything, now would we? It's the kind of simple mistake everybody makes when just starting out in experimental work. You'll learn to be more careful.

"In the meantime, though, it looks like you'll have to re-do the measurement from about here . . ." she touched the screen, " . . . on. The rest of the measurements, excepting of course that part, are simply marvelous. Fine work."

Ramsey smiled ruefully at the compliment. "Thank you."

"I expect that you'll be able to have the whole thing done right by the time

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I get back from Rome." She walked over to her desk and touched the keypad beside her chair. A calendar appeared on the screen. Looking at it, she said, "I'll expect to see you at 9 A.M. on the sixteenth, a week from Monday. We'll have another little chat then."

She tapped the appointment time onto the computer and it appeared dutifully on the calendar.

"Thank you for taking time to see me, Dr. Williamson." Ramsey tried to smile pleasantly. Two weeks of work down the pipes. "Have a good conference."

"I intend to," she said cheerfuly. "I'll send you a postcard."

Ramsey walked out and shut the door behind him. Damn, but she'd laid it on him good. He shook his head in dismay. Still, he couldn't help thinking about how she'd looked today. She certainly was one roxy fox! And cool as well. Cooler than a cryostat. Now, if she ever warmed up toward him, even a little. . . . But that wasn't about to happen. Better get back to thinking about what to do next.

He knew damn well his data was right. Wasn't it? He flipped quickly through his lab notebook. As he'd thought, he had carefully degaussed the magnetometer, checked for residual magnetism, and recorded it carefully in the notebook.

Maybe the magnetometer itself was faulty? Ramsey walked back deep in thought.

Susan sipped her coffee slowly and looked across at him. "Your main difficulty comes in subtracting out the Earth's magnetic field?"

"Yeah," said Ramsey. "My results don't agree with what everybody else gets."

"Can I see?"

"Why not?" Ramsey handed her the stack of hardcopy. She paged through it silently, sipping her coffee. She stopped at a map of Italy. Superimposed on the map in deep red were a series of concentric circles.

"Very pretty," she commented. "I tell you what. I'll be passing over that area Thursday. If I see any giant red circles painted on the ground, I'll be sure to give you a call."

"Huh? You're going to Italy?"

"Yep."

"Why?"

"Just passing through." She smiled, and her eyes glowed. "I'm going to Venus."

"Venus?" he said in surprise. "How come?"

"I've pretty much done all I can here," she said. "I'm studying the Earth elemental—the magical force incarnate in the core of a planet. Very little is actually known about it. It normally takes an earthquake or a volcano to manifest it with any power. It's hard to get permission to create earthquakes, even small ones, though."

"You actually create earthquakes?"

"Well, tiny ones, anyway. Not big enough to measure without extremely sensitive equipment, but big enough to manifest the elemental."

"So how come you're going to Venus, if you're studying the Earth?"

"Hans and I think that we could learn a lot more about the nature of the elemental by invoking the elemental of another planet for comparison. He's

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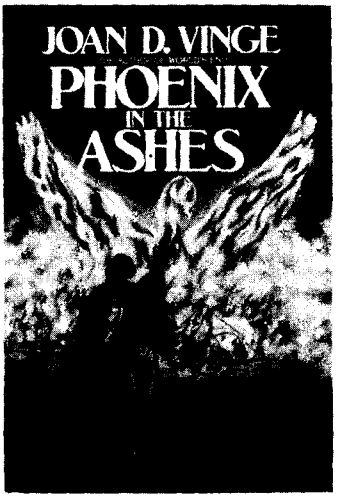

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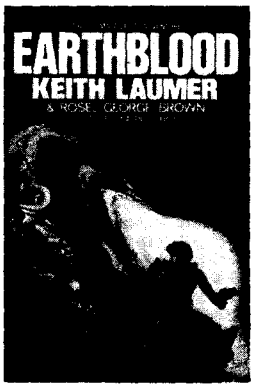

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managed to talk the NSF out of enough funds to send me to Venus to try it."

"But isn't it rather dangerous?"

"Manifesting the elemental? Yes, I suppose it is, but I've been working with it for years, and there are a lot of controls built in. Actually, it's pretty well confined to the Earth's core. I don't expect any trouble."

"No, no—I mean Venus. Isn't Venus rather dangerous?"

She laughed. "You've been watching too many dramatapes. Venus is about as safe as Earth. Maybe safer. Same technology as your little snow-spell, but a whole lot more reliable, keeps the heat and atmosphere out.

"My only real worry is that I might accidentally forget the rules against incidental magic and get myself booted out."

"Rules?"

"Venus base has very strict laws forbidding any use of 'incidental' magic. Lighting cigarettes, untying knots, that sort of thing. It's a sensible enough rule. It's the ward spells that keep the whole place from being uninhabitable, so it's understandable that they'd be a bit picky about anything that could conceivably result in an accidental cancellation of a key spell. But I'll miss being able to play."

She snapped her fingers. A tiny ball of pink fire popped out of the air and settled in her palm. "All us thaumaturges like to play with spells."

She tossed the ball of fire to her other hand and grinned wickedly. "But wanton magicing is a bad habit to get into. After all, if too many people start playing with magic without the strict safeguards built into commercial spells, the side effects could add up, and who knows what could happen?" She snapped her fingers once again. The tiny fireball flashed blue, then vanished with a pop.

"You mean, like, if I made my snow spell wrong it could cause an earthquake in Katmandu?" asked Ramsey.

"A snowstorm more likely, unless you've got a pretty unusual snow ward. For an earthquake you'd need to awaken the earth elemental. That's my job."

Walking to the lab after lunch, Ramsey heard a low roar. As he approached, it got louder.

Now he could hear a voice, barely audible above the roar. Susan? It sounded like she was in trouble.

He ran to her lab. Unlocked. He shoved the door open, and a spray of water rushed out at him.

Inside was chaos. He looked down into the lab. Susan stood in front of a computer terminal, waist deep in swirling brown water. Her hands flew about frantically as she intoned a rapid series of spells. In front of her, a fountain of water gushed out of midair two meters off the floor. Arranged in a circle around this strange waterfall burned six candles in arcanely carved copper stands.

Ramsey ran down the steps and waded into the room.

"Susan! What's going on?"

She looked up. "Ramsey! Thank God! I've got a runaway! If the water rises up and puts out the candles, we're in big trouble!"

The candleholders were already submerged. The water level was about ten centimeters below the flames, rising slowly.

"What can I do?"

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"I don't dare move. Find some way to stop the flow! But for God's sake, don't put out any of the candles!"

"How do I stop it?"

"I don't know! Figure something out!" She went back to chanting.

Ramsey grabbed a book, waded over to the fountain, and pressed it against the stream of water. Water spurted around the edges unimpeded. He pressed harder. The book passed right through the source of the waterfall. Ramsey, unprepared for the sudden loss of resistence, nearly fell on his face.

This wouldn't work. He needed another approach.

A fire extinguisher caught his eye. Good against fire, not water. Or was it? He grabbed it off the wall and tried it. Yes; the right type. He aimed it at the fountain and blasted. The frigid blast froze the water where it struck, but the torrent rushed the ice away as fast as it formed. No good.

He walked around the fountain, looking for a weak spot. The water was now about three centimeters from the candle flames. Susan had paused in her chanting and was watching him.

From the back, he could see that the water came from a one-centimeter hole suspended in midair. If he could block it, the flow would stop. He tried the extinguisher. By directing the cold blast around the edges of the hole, he found he could create a ring of ice, hanging in the air, through which the torrent passed. But the hole wouldn't freeze closed; the water was moving too fast.

Holding the extinguisher on the hole with his left hand, he rummaged through his pockets with his right hand until he found a coin of the right size. He pulled it out of his pocket and carefully placed it up against the ring of ice from the back. The water pressure pushed it up against the ring and held it. He used a blast from the fire extinguisher to freeze it into place.

The torrent stopped.

"Great!" said Susan. "Hold it there while I reverse the invocation." She tapped something into the qwerty behind her and then made a gesture. The water started to drain. "Okay, now extinguish the candles."

When Ramsey blew out the last candle there was a soft pop. The ice-coated coin fell into the water. He walked over and passed his hand through where it had been. Nothing there.

Somewhere later they sat in the coffee lounge sipping hot chocolate. "You were quite the sorcerer's apprentice today," Ramsey commented. "What was going on back there, anyway?"

"I don't know exactly," replied Susan, "but I can guess. That lab is also used for Kirschmeyer's intermediate thaumaturgy course. I think one of the students set up to summon the air elemental and screwed up. Instead of calling air, he somehow got the water elemental. Rather than abort the summons, he panicked and ran. He must have left a latent connection with the nearest large body of water: Lake Michigan.

"I should have done a latency check before I started work. I was in a hurry, though—not much time left before I leave—and skipped it. So when I invoked the earth elemental, I inadvertently opened the portal at the same time.

"That's about it. The portal was

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within the pentacle I'd made for the earth elemental; so I couldn't dismiss the earth elemental until it was closed. I couldn't close it until there was nothing flowing through it. And I couldn't leave my own pentacle, or I'd lose my control of the earth elemental. So I was stuck."

"What would have happened if I hadn't come along? Kept on gushing until it drained the lake?"

"Oh, no. After an hour or so the portal would have phased out. By that time the water would have made quite a mess, though."

"Oh," said Ramsey. "So there wasn't ever any real danger?"

"No," said Susan. "Actually, the water elemental is pretty tame. That's about as far out of control as I've ever seen it. The one I'm working with—the Earth elemental—is quite a bit more powerful. In fact, if it were ever fully summoned it would be rather awesome. Since its power is concentrated at the center of the earth, though, it's pretty hard to awaken fully. The research I do invokes its presence without really fully awakening it. Tickling the toes of the sleeping giant, so to speak."

"That's not dangerous?"

"Not really. Remember, the center of power is seven thousand kilometers away. Here at the surface the earth elemental is pretty weak. It would be different if we were near a power locus, like an active volcano or an earthquake zone."

"I see," said Ramsey. "Tell me, what exactly is an elemental? It's something you've talked about, but I don't really know just what it is. Something to do with Earth, Air, Fire, and Water; right?"

"Something like that," she said. "Any sufficiently complex ensemble of symbolically interrelated objects, when interacting with a symbol manipulating object, such as a man or a large computer, will exhibit non-stochastic behavior—"

"Thanks a lot," Ramsey interjected. "How 'bout doing it in English?"

"Sorry," she said. "Let's see. Inanimate objects sometimes react to magic as if they had intelligence of their own. No, that's not quite right . . . call it volition. They react as if they had a will of their own."

"Sure," said Ramsey. "That's just Murphy's law. I used to have a '34 Sparrowhawk that damn sure had a mind of its own, I'll tell you."

"Well, that's partly it. In general, this only applies to really large systems, though. Things much more complicated than a car. The ocean, the atmosphere . . . the earth. In terms of thaumaturgy, we can deal with these almost as if they were separate, quasi-sentient entities.

"Whenever thaumaturgy is done on such complex systems, portions of the system you don't intend to disturb are still necessarily affected by the magic. This excess power—call it the side effect if you want—is free to be manipulated by the 'volition' of the entity, which we call an 'elemental.' "

"So an elemental isn't something that's already there. It's something you create when you do magic."

"Not really. The elemental is inherent to start with in any complex system. But until that system is acted on by sym-

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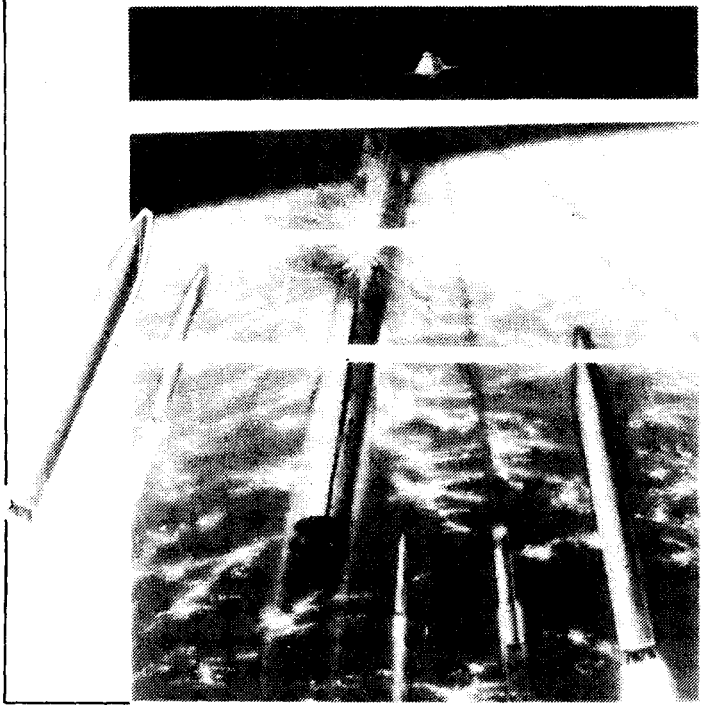

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bol manipulation—magic—the elemental is constrained to obey statistical laws. The use of magic can remove these constraints, and thus unleash the elemental."

"Oh," said Ramsey. "So what do you do? Talk with it? What's it good for?"

"You can't really talk with an elemental. It has no true intelligence. At least not as we know it. You can communicate with it somewhat, using a symbolic meta-language. Aside from studying the elemental for research, like I'm doing, there's several things that elemental magic is practical for. For one thing, it's very useful for power control. An elemental has direct, fine control over huge amounts of power. The energy has to be already there; the elemental just gives you the control."

"I see," said Ramsey. "Kind of like a light switch."

"Right. Or a detonator."

Over the next couple of days Ramsey recalibrated all his equipment, changed his instruments, took readings at every time of day, and tried every trick he knew to eliminate any noise in his readings. Finally convinced his data was right, he set out to map the disturbed region in detail.

"Need help?" Susan's voice drifted in from the open door.

"Oh, hi, Susan," Ramsey said. He was perched precariously on top of a stepladder, positioning little probes over a four-meter plastic sphere representing the earth. "Yeah. Watch the display screen and shout whenever the position marker goes over a hundred. That way I can focus all my attention on the vernier."

"Sure thing."

After a while the readings stopped. "There! Now let's take a look at what we've got." Ramsey got down, walked over to the terminal, and called up a plot.

"Hey, best data I've got in a long time. Wanna stay on and be my assistant?"

"Love to," said Susan. " 'Long as you work fast. I'm leaving tomorrow morning."

"You're leaving tomorrow? But I thought you weren't leaving until—" He stopped and thought for a moment. Could it be Wednesday already? "Huh! It doesn't seem like so much time has gone by!"

"No, it doesn't," she said in a small voice. She hesitated and started to say something, stopped and looked at him for a moment, then glanced away quickly.

"So what does this new data show, anyway?" she asked.

Ramsey looked it over. "The anomaly has localized and grown somewhat more intense." He walked over to the screen and touched a control. A map of the world superimposed itself on the data. "Just south of Rome."

"What's this?" Susan asked, pointing to a squiggle at the bottom of the screen. "Looks almost like the signature of the Earth elemental."

"There's a quick modulation superimposed on the steady anomaly field." Ramsey touched the screen and a scale appeared on the axis.

"Well, how 'bout that!" she said. "It is the characteristic of the Earth elemental. Wonder why you should pick

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that up? You wouldn't believe the sort of things we do to get that clean a signal. Some people just have all the luck."

"Luck!" said Ramsey. "What luck? How do I get rid of the damn thing?"

"Well, it's not coming from *my* lab. I haven't manifested the elemental since the day we had that problem with the water elemental. Why don't you ask Kirschmeyer? I'd bet that either he's running something that's interfering with you or else he knows who is. Can't think what it might be, though.

"Anyway, gotta go. I have a ton of stuff I got to take care of by tomorrow, or else. You take care of yourself now, okay?"

Before Ramsey could reply, Susan ran up to him, stood on her tip-toes, put her arms around him, and gave him a quick kiss. Then she turned and ran out of the room. Ramsey stood there startled for a moment, staring at the open door.

"But how do I get this elemental out of my system?" he called after her.

"You have problems, see Hans," came the faint reply.

Giuseppe looked out in amazement at the vineyard behind his house. Grapes as big as a man's fist! Who had ever heard of such a thing? He pulled out the amulet and looked at it dubiously. He had *la paura*, the feeling of something bad about to happen. But what person stops just when things start to go well? He shook his head and once more began to make the now-familiar set of gestures. As he started the chant, he could feel the power begin to draw itself about him.

Away in the distance, a plume of steam ascended from the mountain into the clear blue sky. Just as it had done on afternoons like this for thousands of years.

Late Wednesday night, Ramsey was still trying to pinpoint his problem. About midnight he ran into Susan outside her office. "Susan! You're still here? I thought you left hours ago."

"I should have. Just one more thing to finish off before I leave. You ready for a break? Want to get some coffee?"

"Sure."

Over at the coffee lounge, Ramsey asked about something Susan had mentioned earlier. "The reason the ancients never got their magic technology to work is that they never learned that most spells change with time?"

"Partly. So on the rare occasions somebody wrote down a working spell sequence, in a decade or so it would be useless anyway. The so-called 'magicians' back then were pretty secretive about what they did. They didn't write down very much. Also, even when they learned that a spell sequence had changed, they had no method to figure out what it changed to."

"How's that done now?"

"You can get good approximations by analytic methods. To get a spell exactly, we do an exhaustive computer search. We just have the computer try out every possible variation on the initial approximation until we get the answer."

"You mean computers can do magic?"

"*Mais oui*. Of course. Magic is just a form of mathematics. Anything that can manipulate symbols can do magic." She looked down at her coffee. Cold.

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She muttered a spell and snapped her fingers. "Want yours warmed up too?"

"Warmed up? It's just barely cooled down enough to drink," he said. "So if they had computers in medieval times, all the would-be witches and sorcerers would have been able to do real magic?"

"Unlikely. They had a lot of other misconceptions, too. One or two might have lucked onto a spell that worked, but mostly they didn't go about it in the right way. First, they expected their spells to make sense. They thought the symbols used in thaumaturgy should mean something in English, or at least in Latin or Sanskrit or something.

"Second, a whole lot of what they tried to use magic for back in the middle ages simply can't be done by thaumaturgy. Turning lead into gold, coal into diamond; that's easy. We do that routinely. But things like eternal youth, or love potions, those you can't easily do using magic. Biological systems are just too complex. For that sort of stuff you need a biochemist, not a magician."

"You don't say. Know any who can get me some of that elixir of eternal youth?"

" 'Fraid not. I know a few who are working on it."

"Figures. How about a good love potion, then?"

"That can be arranged. But what would you need a love potion for, though?" She looked at him coyly.

He missed her look, or else ignored it. "Oh . . . I'm sure I could find some use for one."

"It turns out that you can't actually make a love potion. Love isn't something you can turn on and off." She sighed. "Unfortunately."

She looked up at him. "But sex, now . . . that's something simple, and relatively well understood."

Ramsey laughed. "Well understood? It darn well ought to be, considering all the time people spend thinking about it."

"Oh, Ramsey, you're impossible," she said. "Won't you let me keep any dignity at all?"

Ramsey laughed. "Sorry," he said. He walked over and cradled her face in his palms. Then he kissed her.

"That's more like it," she said.

2. Susan

When Layr came on shift he immediately felt something was wrong. The violet glow from the transfer pentacle lit the room almost brighter than the fluorescent lights, too bright to look at directly. He looked at the total power indicator. One hundred eighty percent of nomimal power. He'd never seen it so high.

Carlo came in a moment later. "Something's wrong, sir," he said immediately.

Layr's opinion of the boy went up measurably. "I know. Do you know the shutdown procedure?"

"Of course."

The spaceport launch system perfectly exemplified the synthesis of the old technology with the new. Antimatter power source held in check with thaumaturgical wards; computer-generated spells regulating the fire elemental that controls power flow to the bank of positronium lasers that boost the shuttles; the whole complex located at a thaumaturgical nexus to enhance the effectiveness. Simple enough in concept,

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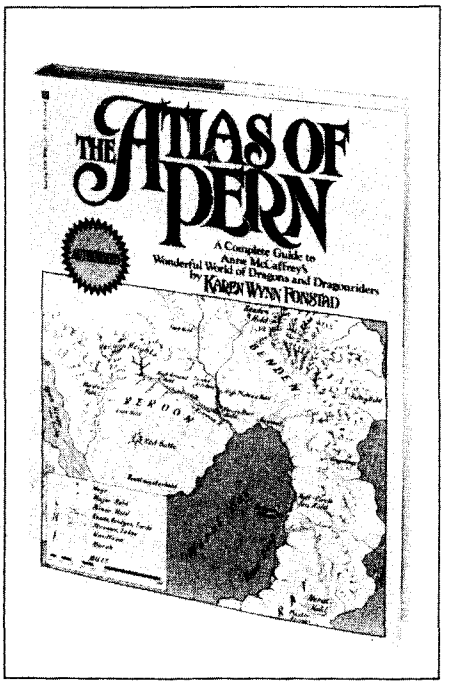
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although rather complicated in the actual working details. What could be going wrong?

"Drop her down to standby level."

Layr walked over to a control phone, picked it up, and pressed a button.

"This is power control. We've got a possible malfunction; we're going offline until we can do some diagnostics. No, I don't know what it is yet or if it's going to be serious. I can't say how long. Better cancel all lift-offs for today. I'll call if it looks like there'll be any danger to the spaceport. So far we're just being cautious. Right. Will do. With any luck, we'll be back on line tomorrow morning. Hold tight. 'Bye."

He put down the phone and walked over to Carlo. "Well, my friend, it looks like we've got a job to do today."

Much later, the sun was just beginning to peep into Ramsey's apartment when Susan slipped out from under Ramsey's arm and began quietly to put on her clothes.

"I'm sorry, my love," she whispered, kissing him lightly on the forehead. "I wish we could have had more time. *Adieu, mon amour, et au revoir.*"

When Ramsey awoke, she was long gone.

Three hundred miles off the coast of New Zealand, a small group of puzzled geologists tried to determine why the cone of Manatla had recently and unexpectedly gone dead. Manatla was the newest of a chain of tiny volcanic islets on the edge of the Pacific ring of fire; it had sprouted out of the ocean floor in a burst of flame and soot in the summer of 2053.

Its arrival had been predicted well in advance; and it was not expected to stop erupting until well after 2100. The failure of the tiny volcano was an unexpected surprise.

Of course, the geologists were looking for the problem on the wrong side of the world entirely, but that was not at all obvious. Not yet.

Susan arrived in Naples tired, but too excited to sleep. The Venus ship left the next morning from the Napoli spaceport. The NSF had provided a room at the spaceport Hilton for the night. She tried to read, but somehow couldn't concentrate on the screen. She found a sliding door opening onto a tiny balcony and went outside.

Looming out of the cloudy night was the immense bulk of the mountain Vesuvius. The European spaceport had been built practially atop it, she recalled, because the presence of the volcano made the spot a thaumaturgical nexus. This made it easier to control the fire-elemental spells used to boost spacecraft.

The volcano would also make this a dandy place to invoke the earth elemental, she thought. But dangerous. She remembered how she had told Ramsey about the indiscriminate use of magic. Should she call him? What could she possibly say to him, after last night?

Instead she undressed and went to bed, dreaming inchoate fantasies about earth and fire, volcanoes, spaceships, and pentacles.

She was awakened at ten by a call from the spaceport. Her Venus flight had been postponed a day due to some unspecified problem with the launch

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system. They were terribly sorry. In the interim, her hotel room and meals would be paid by the spaceline, and if she chose to amuse herself by taking any of the many tours and day-trips offered by the hotel—she thanked them and hung up.

She did not care to amuse herself with tours and excursions, but found she couldn't get back to sleep. She thought about calling Ramsey. Instead she called Kirschmeyer's office. He wasn't in. What time was it back in Chicago, anyway? Oh . . . five A.M. No wonder nobody was there.

She ended up spending the day lounging around the hotel pool, sunbathing and organizing her notes on Earth elemental, working out some ideas to put into action when she got to Venus.

At five in the evening she got another call from the spaceport. The Venus flight was postponed again . . . she'd half expected it. She went over to the tours desk to look for a tour to the Vesuvius crater. None on Saturday. Since she couldn't see Vesuvius itself, she settled on a tour to see the cities it had buried, Pompeii and Herculaneum.

Without thinking about what she was doing she punched out Ramsey's number. She held her breath as she waited for an answer. When there was no answer after fifteen rings, she didn't know whether to be relieved or annoyed. Kirschmeyer wasn't in either. She left a message with the prof's computer telling that the flight had been delayed, then went back to the pool and read the brochures on Vesuvius.

Although technically dormant rather than extinct, she read, geologists had determined that the volcano would not be likely to be active for several centuries at the very least. In the meantime, tourists climbed its slopes and marvelled at the occasional puffs of steam emitted from crevices in the crater, while below, farmers grew olives and grapes on the fertile low slopes of the mountain.

She spent the rest of the evening on the balcony, watching the volcano and daydreaming. By daylight, the crown of Vesuvius was covered by an immense plume of steam. As the sun set, this turned a vivid orange. Even in full darkness, the base of the plume remained faintly luminous, as if lit from below by unseen fires.

Professor Kirschmeyer had Ramsey's hardcopy spread across the floor of his office. He knelt over it, studying intently. A trail of colored chalk dust showed which sheets had been examined. Ramsey looked on from a more dignified position, sitting on Kirschmeyer's desk. After a while, the professor stood up. He pointed at one of the papers with the stem of his pipe.

"Well, mine friend, here we see a steady base of the elemental presence. It flares up to a higher level from time to time, but these occasional flare-ups stopped suddenly, at about the same time my Susie left us. Other than the fact that this very definitely is the signature of the Earth elemental, I can see no connection to my work. I wish Susie were here—she might have some ideas. Me, I'm lost."

"If it's not interference from your work, why did it stop when she left?"

"Coincidence. Something else must have stopped, or started, at about the same time."

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"Like what?"

"If I knew that, my boy, most certainly I would tell you, and we'd have the problem solved."

"So what do I do now?"

"Next we all go home and get some sleep and think it all over. In the morning I meet you in your lab, *ja?* and maybe we have some better ideas then."

"Right."

As Ramsey and Kirschmeyer left the office, the 'incoming' call light on the terminal started flashing. Kirschmeyer reached out and flicked the switch over to 'not receiving.'

"Shouldn't you answer that? What if it's important?"

"I rather doubt it. Besides, I have a reputation to keep up. I answer too many of my calls and people might think I have nothing better to do, no? If it's important, let them leave a message with the computer."

In Rome it was almost morning. When the conference on interstellar winds ended, Dr. Williamson had intended to spend the weekend in Rome with Count Raminski, but he had unexpectedly taken ill. Might as well see something of Italy, she thought. It's been ages since I've been here.

She wandered into the Sheraton lobby and gathered a handful of pamphlets advertising tours and attactions of Roma and vicinity. One with a picture of a flaming volcano on the cover caught her eye. "Pompeii: a City of Entombed."

The drive from Rome to Naples was beautiful but hair-rising, even in her little sportster, which was both smaller and more maneuverable than most of the vehicles she passed. The Italian drivers more than made up for the difference by the gusto with which they drove, bordering somewhere between hysterical and insane. South of Naples the road to Pompeii snaked along volcanic cliffs at the edge of the brilliant blue sea. Far below she could see sheltered coves and fishing villages, along with occasional empty beaches of brilliant white sand.

Even on the twisting mountain roads the drivers raced with insane verve. All she could do was hope that when one of them finally managed to push her off the narrow road, she could eject before the car started tumbling. It was a long way down.

Somewhere between Naples and Pompeii the skies changed from the oppressive gray clouds of the city into a brilliant sunshine.

"First, make a list, in order of correlation, of all activities or natural phenomena occuring within one hundred kilos of the campus which match the timing of the activity in your data," said Kirschmeyer.

"Right." Ramsey turned to the qwerty, started typing, paused for a second, then typed fast. The viewscreen across from them lit up with a list. Both of them studied it.

"Not much significance, is there?"

"*Nein*. Phone calls to Iceland; purchase of medical textbooks . . . look hard enough and you'll find seeming correlations in any large enough set of random events." He looked over at his pipe. "Tibura naal." The pipe lit with a blue spark. He picked it up and puffed thoughtfully. "Let's try another ap-

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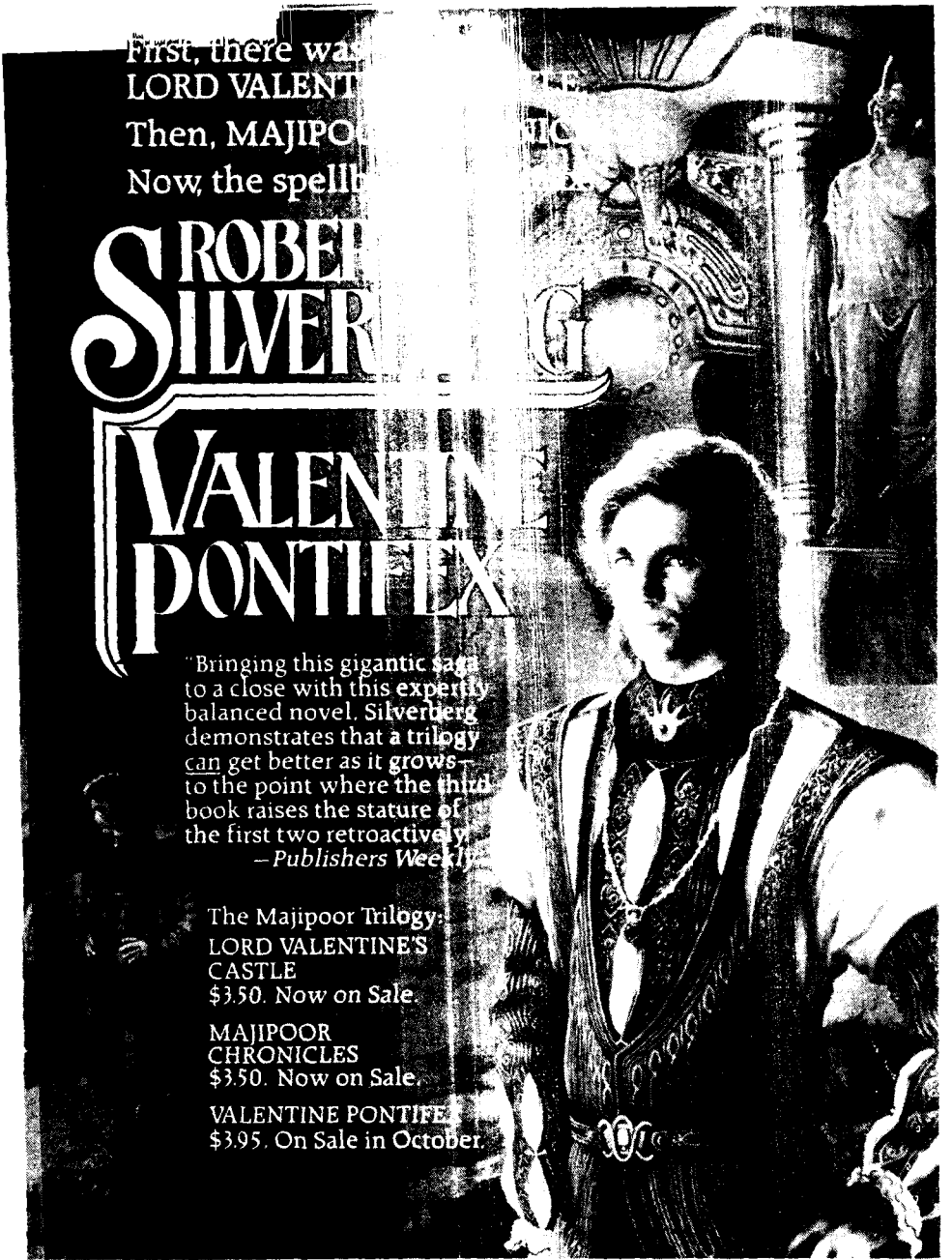
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proach. Your anomaly centers around Rome?"

"Closer to Naples."

"Okay. Try a correlation to activities there."

"Data bank won't be as complete."

"Can you hook an Italian data bank?"

"I can try." He started typing.

"Got it," he said after a moment. The screen blanked and then lit up with a shorter list.

"Jackpot! There's our correlation: launches from Napoli spaceport."

"*Stimmt*. Right enough. It accounts exactly for the sporadic signal, even for the stopping thirty hours ago." Kirschmeyer paused and looked at Ramsey. "Ramsey? Why did the spaceport stop launching thirty hours ago?"

Ramsey typed the question into the computer. " 'Unscheduled maintenance,' prof. Beats me why."

Professor Kirschmeyer looked up. "Ramsey, my friend, I am beginning to get frightened."

"Why? Looks like I'm just picking up interference whenever they launch a shot from Naples. Probably an electromagnetic pulse that just happens to resonate my detector."

"Ah, my friend, I wish I had as little imagination as you. We still can't account for why noise shows up as the signature of the elemental. Do me a favor? Call up a plot of your magnetic anomaly, centered over a map of the spaceport."

Ramsey did so. "Huh! Look at that. It's not even close to exactly centered on the spaceport." He typed another command. "Center is . . . 23 kilometers off, bearing 342 degress. Another map . . . got it. It's centered on a frigging mountain. Vesuvius."

"As should have been obvious to me as soon as we agreed that it was indeed the earth elemental we saw, not some random noise signal. Ramsey, a signal that strong only could come from an earthquake or an active volcano."

"Active? Isn't Mount Vesuvius extinct?"

"Dormant, my friend, only dormant. Sleeping. But I don't think it will stay asleep for long."

"You think it's about to erupt?"

"Yes. Ramsey, this data makes sense only if the Earth elemental has left the center of the Earth and is rising slowly toward Italy, dragging a portion of the Earth's magnetic field with it. Somehow, by someone, it's been summoned. Not merely manifested, like we do here for to study it, but fully awakened and called. Of course, I can't say for certain, but I can't see any other way to interpret this."

"Then we gotta do something. Stop it! Warn people!"

Professor Kirschmeyer put his hand on Ramsey's shoulder. "Hold on a moment, my young friend. Let's get some better data before we start rushing around like fools, eh? Who stirs up a hornet's nest had best be prepared for the stings.

"First, we can connect up your magnetometer to one of my spells invoking the elemental, which will give it a lot better sensitivity for this application. Next, activity on the part of the Earth elemental will be mirrored in the other elementals, particularly ocean and fire. We can set up some kind of monitor on that. Also, it should be possible to trian-

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gulate on the Earth elemental using your technique. Then we can find out for sure whether the elemental is actually surfacing."

"How much time do we have? Shouldn't we get a warning out as soon as possible?"

"That's the first thing we need to find out. I'm hoping we can figure that out when we triangulate. The elemental is rising from the core toward Vesuvius; we need to know how deep it is and how fast it's moving. Until we can give a definite time and estimate how bad the eruption will be, it's worse than useless to try to make anyone heed a warning. If they evacuate prematurely on the basis of a quick guess, people will come back to their homes after a day or so when they see nothing happening. Then when the real warning comes, they'll ignore it. We'd do more harm than good."

"So let's get to work!"

"*Doch, doch*, we shall. I just wish . . . I wish we had Susan here. This is really her field, not mine."

"Not your field? Aren't you her advisor?"

"Oh, yes, her advisor I am. But Susie's work is really pioneering. There are very few people who understand the Earth elemental, and I don't doubt that Susie's the best of them. Certainly she has the 'feel' for it. Myself, I can work with it when I need to. My real skill, though, is with the water elementals —ocean, lake, rivers, that sort of thing.

"But our Earth elemental expert is merrily on her way to Venus, so I guess we'll just have to muddle through the best we can."

"No," said Ramsey. "I don't think she is on her way to Venus. She couldn't be."

"Do you know something I don't know? She left two days ago."

"No she didn't. The spaceport's shut down, remember? No flights."

"That's right. So she must be stuck in Naples. But wait . . . if she didn't leave, I know she would have called me."

"Maybe she did. You don't answer your calls, right?"

"*Stimmt*. Right. She would have left a message with the computer. And I didn't check my office this morning. Let's go. No, you stay here and start programming. I'll go up and see if there's a message from Susie. No, better yet, you go up and see if there's a message, I'll stay here and start working—"

Kirschmeyer turned around. "Ramsey?"

But Ramsey was already gone.

Pompeii was tranquil and peaceful. Susan had expected to see a blasted ruin of rock and volcanic ash, but instead she found a sunny clearing in the midst of fields of olive trees and vineyards. The tourguide went on to take the group past varied excavations and ruins. Susan quietly slipped away from the horde of would-be guides, souvenier sellers, and vendors of 'authentic' relics surrounding the group and found a low stone wall overlooking the site to sit on and contemplate.

Up the dirt road in front of her zipped a sportscar, a sleek late-model Tigershark, gold with black trim stripes and a tinted canopy. As it came by her it abruptly slowed and skewed around in a cloud of dust. The fans revved down

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and the car settled to the ground. When the canopy popped open, Susan was surprised to recognize Ramsey's advisor, Doctor Williamson.

"Excuse me," said Doctor Williamson. "Don't I know you?"

"Susan Robinette. Yes, I work for Hans Kirschmeyer, down the hall."

"Oh, yes, of course. You're the one Hans always talks about, doing the work with the elemental. How unusual to run into you so far from home! But, of course, you must be on your way to Venus. Right?"

"Right," said Susan. "The flight was delayed; I'm killing time until it gets rescheduled."

"What a nuisance. You know, sometimes I think I've spent half my life in airports, and spaceports, waiting for flights, waiting for people to arrive, waiting for people to pick me up. I'd give up traveling entirely, if it weren't the only way to get from here to there."

"You travel a lot, Doctor Williamson? To conferences and such, I suppose."

"Please, call me Jane. No, I was traveling long before I ever got invited to conferences. My parents were both diplomats, you know. When I grew up, I hardly knew which continent to call home, much less which country."

"That sounds so wonderful," said Susan wistfully. "I never went even a hundred kilos from home until I left for school in Ontario."

"You're from Quebec, I take it?"

Susan pouted. "Is my accent still that obvious? Yes, I'm from Saint Andre. It's well north of Montreal, on Lac St. Jean."

"Ah, yes. Beautiful country, that. Well, I can tell you that growing up in hotels and embassies around the world may sound fabulous, but the reality is quite the opposite, I assure you. For one thing, I never had any friends my own age. Just about the time I started making friends somewhere, we'd move, or I'd be sent off to live with my father on another continent, or something.

"Your parents were divorced?"

"Oh, no!" Jane laughed. "But they did hardly ever see one another. Except at occasional diplomatic balls and suchlike. I think they really did love each other, in their own way. You had to be very close to them to be able to tell, though."

"That seems so different from my family," Susan said. "I grew up on a farm; my parents hardly ever got out of sight of each other."

"How did you end up doing thaumaturgy?"

"In high school we had a physics teacher who knew a little thaumaturgy as well. He used to do demonstrations in class. I'd stay after school and help him set them up. I guess I was just naturally good at it. I knew as soon as I tried it that it was what I wanted to do with my life."

"Your parents must have been very pleased."

"My parents were furious. They thought that magic was no fit occupation for a girl: I should learn tractor repair or something practical I could use around the farm. So I could become a good farmer's wife. And if I hadn't won a scholarship to Waterloo that's all I ever would have been.

"You say you never had any friends your own age. Well, you weren't miss-

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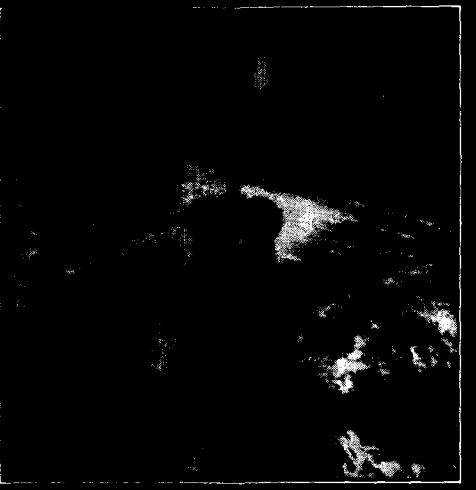

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ing much. It's hard not to know people in such a small town, but there isn't anybody worth knowing."

Jane smiled. "You think you had it rough. My parents didn't ordinarily pay very much attention to me, but when I was sixteen, it somehow dawned on my mother that I didn't have any boyfriends. So my parents somehow got together and arranged a big debutante party for me at my uncle's mansion in New Canaan. A big, high society affair; people flying in from all over the world. They had a lot of fun planning it; they discussed it for months. They never bothered to ask me, of course. I was terrified. When the big day finally came, I couldn't do it." She giggled at the memory. "I couldn't face it. So I ran away. Hitchhiked right across the country in my formal. This big coming-out party, people arriving from all over, and the star attraction didn't even show up. It was talked about for just ages."

Jane threw back her head and laughed. After a moment, Susan joined in.

"So what happened when you finally returned home?"

"But I never did. I worked in San Franciso over the summer, and in the fall I enrolled in Berkeley. I was too frightened to go back, you see. It's all rather funny now, of course."

"Still, it's all made you into a very cosmopolitan woman."

"Yes, I suppose it has. If you think that's worth the price."

"Ramsey is in love with you, you know."

"Ramsey Washington? Yes, I know," Jane said. "He doesn't think I know it though. How well do you know Ramsey?"

"Pretty well, Not well enough, I guess."

Jane looked very hard at Susan. "You're in love with him?"

"Very much."

"Oh. I see." She sighed. "There's very little I can do about his infatuation with me, you know. All I can do is avoid encouraging him as much as possible without actually being rude to him or hurting him too much. But he'll have to grow out of it himself."

"I know. It just seems so unfair, somehow."

"The world isn't fair, dear. We just have to live with it the way it is."

Jane stood up. "Anyway, we're both here thousands of miles from home, we might as well see a bit of it. Shall we?"

3. Elemental

Layr put his wrench down and looked at Carlo. "We're in deep trouble," he said.

"I know."

Fifty hours after the power control had been put into automatic shutdown mode, the power meters still read a hundred and thirty percent. What was more frightening, though, was that the needles had stopped showing a decrease and were now very slowly inching back up.

"What bothers me most," said Layr, "is not that the control isn't working. It's that I don't have the slightest idea *why*. I can think of only one thing left to try."

"Questioning the fire elemental?"

"Yeah."

"This is a dangerous place to summon fire."

"I know it. Have any other ideas?"

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"No."

"Then we'll just have to be very careful. Make a subsidiary pentacle for yourself and be prepared to take over if I'm overpowered."

"Right."

Layr walked over to the main terminal and tapped in a sequence of requests. Two projectors near the ceiling lit up, projecting three unusually complex pentacles onto the floor. Carlo knelt down and began to outline them in paint in case of power failure. Meanwhile Layr called up a review of the spell sequence required and checked it against his own dog-eared manual.

"Sir? Are you planning to have the computer do the invocation, or are you going to do the invocation yourself?"

"Doing it myself."

"Might be better to have the computer do the summons; leave you free to concentrate on contingencies."

"I thought about it. Under the circumstances, I'd rather have the invocation directly under my control. I'd like to be able to switch spells fast if there's any trouble. If I'm harmed, well, that's what you're here for."

"Thanks."

"The antimatter's protected by its own pentacles. I don't anticipate anything threatening it; it should be safe even if the backblast wipes out the whole rest of the spaceport, God forbid. If something does happen to me, though, maintaining the integrity of the confinement pentacle is your number one priority."

"Right."

Layr looked over at Carlo, who had finished outlining the pentacles and was now cleaning the brushes. "Give it another five minutes for the paint to set, then light the candles." He walked over to the control console and picked up the phone.

"Control, this is power. We're ready to summon the fire elemental, at minus five minutes, mark. This should be routine, but I suggest you have your people sheltered just in case." He put down the phone. "Wish I felt as confident as I sound."

Layr positioned himself in the center of one of the smaller pentacles. Carlo lit the five candles circumscribing the large pentacle, then retreated into his own pentacle. Layr looked at his watch, then at Carlo.

"Here goes.

"Diiratah kiimatahi na naratah na diir," he intoned in a smooth cadence. "Kiimatachi, kanahatau'illannaghani. Nehobeth! Na naratah na diir. Diiratah!"

A blue glow formed in the empty pentacle. Layr made a complicated gesture and spoke once more. The glow consolidated into an eerie violet flame.

"*Sassilloe fsartha?*" said the flame with a soft hiss.

Layr watched the computer screen, not the elemental. "Naal tenepah. Anada. Tnillipa pesardathi!"

"*Psillissasi,*" replied the elemental. "*?! Ness, simiss kssissith saar. ?! Simmolayah na.*"

"?!"

"*Ness, simmassis ksaar. 'illissis.*"

"?!"

"*Ness, simallahi sis.*"

Layr turned from the output screen and looked directly at the elemental. He made an abrupt gesture, the reverse of the one he'd made to summon the ele-

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mental. "Diir na hataran na ihatamiik hatariid!" He made another gesture.

"*Ssimiloth? Prissathi iss.*" The violet flame grew wider, brighter, reaching to the edges of the pentacle and seeming to push outward, as if testing the walls of an invisible prison. The candles surrounding the pentacle flickered. Layr stood motionless, watching.

"*Sissarthi.*"

The flame vanished with a thunderclap. It took a moment for the eyes of the two watchers to readjust to the room's light.

"I've never seen the manifestation so weak!" Layr said. "There was hardly any power at all. Damn. We should have expected this. We're so well warded against fire that we should have known that it wasn't causing the problem.

"But what is, then?"

"I couldn't get that. Another elemental. What's next most likely?"

"From the amount of power involved," said Carlo slowly, "It's got to be one of the primaries. Ocean, atmosphere, biosphere . . . Earth. It's the Earth elemental. Right?"

"Yeah. That's the way I figure it, too."

"But the Earth elemental is supposed to be the most stable of all."

"Yeah. And the hardest to control. Somehow it must have been awakened. But by whom?"

"I repeat, this is an emergency. It is absolutely essential that she get in touch with me. Make every effort to have her found. Thanks!" Kirschmeyer hit the kill button on his console and turned to Ramsey.

"No luck. The tour bus returned from Pompeii half an hour ago, and she wasn't on it. She's not in her hotel; she's not at the spaceport. I'm having the police watch for her. In case she comes back to her hotel room, I left a message for her with the computer there. What else can I do?"

"How long before we get the data to triangulate the elemental?"

"Rosenblum promised to call with the data, in," he looked at the screen, "exactly forty-five minutes."

"Then I see only one thing left for us to do," said Ramsey.

"What's that?"

"Get some breakfast."

"Good idea. First we breakfast. *Then* we panic."

"Jane! Stop the car! Quick!"

Doctor Williamson slammed on the dragskids. The car skewed around in a cloud of dust.

"What's wrong?"

"Those farmers. Hold on here a sec, huh? I want to watch what they're doing."

Jane killed the lift fans and looked out across the field to where Susan had pointed. In the distance, two men stood by a tractor, facing the sun and waving their arms in a complicated pattern. Jane recognized the sight of people casting a spell. What was so unusual about that?

"What—"

"Quiet!" whispered Susan, gesturing with her left hand. "Maybe I can hear what they're saying."

Now that the fans had revved down, Jane could barely hear the words coming from across the field. They made no sense to her. She reached across into the glove compartment, got a pair of field

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glasses from under the seat, and handed them to Susan without comment.

"Huh? Oh, thanks." Susan grabbed the glasses and peered out across the field. "*Merde*. Just what I thought I saw. I'd recognize those gestures a mile away. They're invoking the Earth elemental!"

"So?"

"Jane, that's an *active volcano* over there. The only reason I can think of to invoke the Earth elemental at this particular spot would be if you wanted to commit a particularly spectacular form of suicide! Just what the hell do they think they're doing?"

"Let's ask. Climb back in." Jane shoved the lift fans into high, and the car bobbed into the air. "Hold tight." She twisted the wheel and gunned it. The car shot off the edge of the road, jumped across the roadside ditch, and skittered across the field.

"I don't expect they'd speak English," Susan said doubtfully.

Jane laughed. "So what? Susan, I can't even count how many languages I know. If they don't speak English, I'll translate for you."

"I guess there is one advantage in growing up on five continents after all." The car bounded across another ditch and skidded to a halt beside the surprised farmers.

Layr completed his spell and watched the needle swing over. "Mother of God!"

"What is it?"

"The Earth elemental presence should be barely detectable through all our shields. Instead it's off the scale. That's at least fifty thousand percent amplification!"

"You're summoning it?"

"Hell, no! Do I look stupid? I can get a reading without doing a full invocation. At these insane power levels, even that could be risky. What in hell's name is going on?"

"Sure the meter's working?"

"Yeah. Anyway, it all fits. It explains where our excess power is coming from. We're tapping the Earth elemental via Vesuvius. But how can it be that powerful? It's over seven thousand kilometers away!"

"Could it have moved closer?"

"Seems awfully unlikely. It would take half a dozen thaumaturges to coerce it to the surface . . . still, that would explain the readings . . . if the power level is correct, it must be, let me see . . . three hundred kilometers away? And getting closer every minute."

"What if it were a lot of untrained magicians instead of a few trained ones?"

"It would take a lot more. Hundreds. And why would they want to do it?"

"Terrorists? Maybe they want to destroy the spaceport?"

"No. Doesn't make sense. Carlo, any terrorists with the capability to summon the Earth elemental to the surface could just as easily make an antimatter bomb. . . . Holy God, the antimatter! Carlo, what's the current reading on the antimatter level?"

"213 Kilograms, Mr. Layr."

"We're in a lot worse trouble than I thought. If the elemental really is surfacing, the volcano is going to erupt."

"Erupt? You mean like Pompeii?"

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Carlo turned white. "My God! That would kill fifty thousand people!"

"A lot worse than that, Carlo. That was just an ash cloud; a natural eruption. This would be forced eruption. These days the vent of Vesuvius is pretty well plugged. It won't just erupt, Carlo. It'll explode. Like Krakatoa. But that's not the worst of it—"

Carlo was silent for a moment. "Oh, gods . . . the antimatter. The wards might not hold. Sitting on top of a volcanic explosion? They're not designed for that kind of stress. They'd overload. We'll be sitting on top of two hundred kilos of unshielded antimatter. . . ."

"Do you know how big an explosion that would make?"

"No. I can't even imagine it. Let's see . . ." Carlo turned to the computer. "Total conversion, 425 kilos . . . $E=mc^2$ . . . Ten thousand megatons. Holy mother, that's a million times bigger than Hiroshima! Why, that's . . . that's a fireball fifty kilometers across!"

"Pretty close," said Layr. "You've got to figure that only about half of the energy will be absorbed, the rest will be radiated directly into space as gammas."

"That's still pretty catastrophic," said Carlo. "Let's see, five PSI overpressure radius, 90 kilometers. Praise the gods, it won't take out Rome, at least."

"Wrong. We're almost on the sea. The blast will raise a tidal wave, I can't begin to calculate how high. It'll splash the Mediterranean dry like a puddle stepped on by a giant. I don't think there'll be much left of Rome after the tidal wave hits it. I don't think there'll be much left of anything south of the Alps."

"What do we do?"

"Neither one of us is qualified to handle this one. We need to find someone with some experience in handling the Earth elemental. And we need to do it fast. . . ."

"Still no luck in contacting Susan?" asked Ramsey.

"No."

"What then?"

"According to your data, my friend, the elemental is going to surface at Vesuvius in seven hours. No way to stop that. If someone were right there when it happens, and if they had your data, and if they had enough experience with the elemental, then there would be a chance that they could calm it."

"Yeah?"

"Yeah. Maybe."

"Who has enough experience?"

"Susan. Me. Maybe four, five other people in the world. Nobody we could contact in time. Susan knows it best."

"But she's out of touch."

"Right."

"So it's gotta be us."

"Right."

"Let's hope there's a flight. We don't have any time to spare."

The gold Tigershark sped down the twisted road at almost two hundred klips. Some of the turns were rather wide; hovercars are designed for speed, not for maneuverability. When the road turned too sharply, Jane just cut across the fields, dodging between the olive trees, rather than slowing for the turn.

"I've been pretty dense," Susan

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said. "It should have been obvious to me from the start. . ."

"What?" replied Jane. "That a bunch of Italian peasants were inadvertantly calling up the Earth elemental while trying to improve their crops? Why should that have been obvious?"

"I should have figured that somebody was messing with the Earth elemental. That should have been obvious as soon as I saw Ramsey's data."

In front of them the tiny dirt road joined up with the highway. "Which way?" asked Jane.

"Vesuvius," replied Susan. The car shot to the left. "No, wait . . . first the spaceport Hilton!"

Jane slammed the stick to the side, and the car spun around backward without slowing down. Then she hit both the dragskids and the turbos at the same time. The car stopped as if it were suddenly nailed to the ground, then shot off in the opposite direction.

"I've never seen anybody drive like that before!" Susan said. "Where in hell did you pick up that trick?"

"Used to play polo for Berkeley," said Jane. "What were you saying about Ramsey's data?"

"His data showed the signature of the Earth elemental."

"His equipment wasn't calibrated right."

"I think it was. I was just too blind to see what it meant."

"You looked at his data? You really think it was valid?"

"Absolutely."

Jane was silent for a moment. "How bad is the situation? You're sure that just getting them to stop using that spell won't be enough?"

"Quite sure. The elemental's been called; it's just taken a long time to respond. But when it gets here, all hell is going to break loose over this part of the world."

"Then it's all my fault. I was working so hard at ignoring Ramsey I went too far. I hardly even looked at his data."

"But you didn't know what to look for, and I did."

"That doesn't matter. It was my job to know what he was doing, not yours."

The spaceport Hilton appeared suddenly on the right. Jane cut across a couple of corners and screeched to a halt in front of the door. They both jumped out of the car.

Upstairs, Susan dumped open her suitcase and started to grab out various items of magical paraphernalia.

"You've got a bunch of urgent messages waiting on the room console," Jane called back to her.

"Who from?"

"Four messages from Hans Kirschmeyer . . . One from Ramsey . . . One from the spaceport ticket office . . .One from Christian Layr. . ."

"Who?"

"Somebody called Christian Layr . . . the message says he's the chief engineer of power control at the spaceport. He wants you to get in touch with him, as soon as possible, urgent."

Susan laughed. "I'll bet it is! Looks like somebody else has figured out what's going on!"

"Shall I call him?"

"No time! If anybody else calls, put a message in the computer saying I'm heading for Vesuvius." She grabbed a portable console from the desk and

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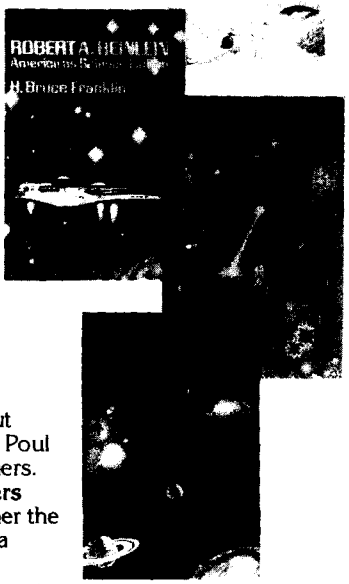

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threw it on top of the stack. "Let's get out of here!"

As they reached the car, Jane asked, "How likely do you think it is you'll be able to control it?"

"I give it about a fifty-fifty chance," Susan said. "But I've got to try at least."

"Think you can handle the car?"

"Not the way you can."

"But you can drive it?"

"Sure."

"Take it then. If things are as bad as you think I'd better warn the authorities."

"What can they do?"

"They can start evacuating the area, for one."

"You trust my judgement enough to start a full scale evacuation?"

Jane looked at her for a moment. "You seem pretty certain."

"Oh, yes, I'm pretty damn sure. Okay, go to it. If it's as bad as I think, though, you only have a few hours left. That's not enough time to get everybody out of Italy even if you could convince them to go."

"True," Jane said. "But we're morally obligated at least to give the warning. The rest is up to them."

Kirschmeyer's car was a battered BMW *Landstreicher,* but he drove with every bit as much verve as Doctor Williamson. He drove up onto the walkway in front of the terminal and parked.

"You're just going to leave it here?" Ramsey asked.

"Why not? So they tow it away. We've more important things to worry about, *nein?*"

"Right." They ran into the terminal.

"*Flight 119, Naples and Spaceport Europe, boarding in ten minutes gate 99. Flight 119 to Naples, boarding in ten minutes.*"

"That's us," said Ramsey.

"*Ja.* And just enough time to try once more to get a hold of Susie," Kirschmeyer replied, heading for a public terminal.

A moment later he shouted. "Bingo!"

"You got her?"

"No! I got her computer. She left a message for us. She's figured out what's going on; she's headed for Vesuvius to try to turn it back! Good girl; she's worth the two of us put together."

"What now?"

"We still have to go there. She's out of contact again, but she needs the data and the equipment I've brought if she's going to have much of a chance of stopping it. We don't both need to go. One of us is enough. Are you sure you want to do this?"

"No way I'm staying out of the action, prof."

"It'll be damn dangerous to be there, even with what I brought for her. Damn near impossible without."

"I'm going," Ramsey said. *You're going,* he thought, *how could I do less?*

"I can't talk you out of it?"

"No way."

Kirschmeyer clapped him heartily on the shoulder. "Good lad! I thought I could count on you! It warms my heart to know that young men are still brave and foolhardy. My Susie could have picked a lot worse for herself, *ja!* I wish you both the best of luck in dealing with the volcano."

Ramsey suddenly had a sinking feel-

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ing in the pit of his stomach. "You mean you're going to stay behind?"

"Only one of us is needed to get the stuff to her. With you there by her side to give her support, what use am I? All I ever knew about elementals I have taught her, and well she learned, and far more besides. She has no need of me. With you, her brave young man, there at her side, if there is any way for her to stop the volcano from blowing you both into little teeny bits, I'm sure she will find it. She will have the motivation, no?

"But for me, I have my own work to do. I have another flight to try to catch. To New Zealand."

"New Zealand!" Ramsey said. "You're running clear to the other side of the world?"

"*Ja, ja,* New Zealand it is. And I must run. Give Susie my love, yes? And, absolutely, without failure, be sure to tell her where I went. Tell her she can count on me if she needs me." Kirschmeyer turned and ran.

"Coward!" Ramsey shouted after him.

"No time to explain! Ask Susie!" Kirschmeyer shouted back over his shoulder, then, dodging pedestrians, disappeared into the corridor.

"*Flight 119, now boarding at gate 93. Flight 119, Naples and Spaceport Europe, gate 93.*" Ramsey turned away from watching Kirschmeyer and walked over to board.

The prefect of Naples put down the handset with a scowl.

"Bad?" asked his chief of staff, a rather serious, hard-working young man without whom the governor would not be able to get anything done at all.

"I don't know," said the governor slowly. "If it weren't for the coincidence, I'd probably just dismiss them as crackpots. . . ."

"What?"

"I just got two calls, from two entirely different people, both urging me to evacuate Naples and the entire surrounding countryside."

"But that would be impossible! Why?"

"One of the calls was from a rather well known professor at the University Padua. A colleague at the University Chicago, name of Kirschmeyer, informed him that data they'd collected indicated Mount Vesuvius was about to become active again, probably with a rather large explosion."

"Vesuvius? That's ridiculous."

"Maybe so. He said that he could personally neither confirm nor deny the prediction, but what data he could take showed something unusual was happening, or about to happen, on or near Vesuvius."

"He suggested you evacuate?"

"No. He said he was passing along the information, and that whether to evacuate the area or not was a decision only I could make."

"And the other call?"

"Was from a woman, an American, also a professor at the University of Chicago. A Doctor Guenevere Williamson. Rather well known in planetary physics, you may have heard of her. She happens to be visiting Naples. She stated that one of her students had evidence that Vesuvius was about to explode. She suggested in the strongest

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possible terms that I give order to evacuate the entire area."

"But such an evacuation would be a major disaster, chief! And keep in mind that one of the things that American university students are famous for is the pulling of pranks—"

"True. It could be just a prank. But if so, one in extremely poor taste. Or it could be simply a mistake."

"You're thinking about Pompeii," Ben stated.

"No. We've lived with the memory of Vesuvius and Pompeii for many centuries. I'm thinking more about another volcano. Pelée, a mountain on the tiny French island of Martinique. It's been one of my nightmares for many years. In 1902 or so, I don't remember exactly, Pelée started to make noise and shoot out sparks. The population of Saint Pierre, at the foot of the mountain, were terrified. But the governor-general, feeling that a panic would be worse than the risk of an eruption, put out the word that nothing was wrong, that the people should go about business as usual. Later it got still worse. Ignoring the governor's orders, people began to flee the city and head for the highlands, far from the smoking mountain. To maintain order, the governor ordered the soldiers to bar the streets and to close the port, to prevent anybody from leaving."

"And?" *prompted* Ben.

"So the evacuation was halted, and a panic in the city prevented. Order prevailed. Forty thousand people were in the city when the mountain exploded. When rescue ships finally arrived, three days later, there was only one survivor. Only one in the whole city."

"Oh."

"That was long ago, of course, and on another continent. But, Ben, there are three million people in greater Naples. And I'm responsible for all of them. Until now, I've never regretted going into politics. I've always felt I was needed, that I could do a good job, better than—or at least as good as—anybody else could do. I like to make tne city run smoothly, to try and make the lives of my people a little better, a little happier.

"I can't let all that go to waste, Ben. I may make a name for myself as a foolish old man who let a rumor panic three million people. But still, I can't make any other choice.

"We'll make the evacuation as smooth and orderly as humanly possible. But, right or wrong, I'm going to evacuate the city."

3. Volcano

Carlo shut off his qwerty and turned to Layr.

"Still no luck in finding someone qualified to work with the Earth elemental, eh?" Layr asked without looking up from his own qwerty.

"Not exactly," Carlo replied wearily. "The data bank lists only seven people in the world as being qualified. One of them turns out to be here at the spaceport right now."

"Here? Who? Where at the spaceport?"

"Listed as being at the Spaceport Hilton. A Susan Robinette. I've been trying to contact her, in your name, for the last hour without success. I just got a message from her computer. She's right now on her way to Vesuvius—"

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"Vesuvius? Then she's already aware of the problem!"

"Unless it's just a sightseeing trip."

"Have you looked outside? Nobody sane would go sightseeing to Vesuvius today. We'd better hope she stops the eruption. We can't worry about that, we've got to do something about the antimatter."

"If she can stop the volcano, we don't have to worry about the antimatter."

"But maybe she can't. I've been keeping power readings on the elemental; it's powerful, unbelievably powerful. At this stage, I'm not sure there even *is* any way to stop it."

"What is there we can do about the antimatter? Can we invert it?"

"I wish it were just that easy."

"Why not? It's a simple spell. About the simplest there is. Reverse antimatter into matter; should be about as simple as turning a left shoe into a right one."

"Oh, it's a simple enough spell, all right. But there are two reasons we can't use it. You've heard of the UN Commission on Peaceful Uses of Thaumaturgy? They've set a ward spell over the entire earth to prevent matter/antimatter inversion spells from working. Can you imagine what would happen if any backyard thaumaturge decided to make some antimatter just for kicks?"

"Yeah. But couldn't we circumvent that somehow?"

"Yes, we probably could. All they can do is try to slow down amateurs; they can't stop a professional. It would take us some time, but we could do it.

"The second problem is that in order to invert our antimatter, we'd first have to take down our own wards. . . "

"Oh," said Carlo. "Of course. And to do that would initiate the very disaster we were trying to avoid." Carlo thought for a moment. "What if we were to set up a pentacle around the whole power control? Then invert everything inside; the building, the air, the computers, even ourselves? Turn it all into antimatter. All but the antimatter, which is warded itself, so would stay unchanged. If we ourselves are antimatter, we can release the inner wards without any harm. Then we can do another inversion, and we're safe." Carlo grinned.

"Clever," said Layr. "Just one problem. What happens if the volcano goes off when we're halfway through?"

"Oh," said Carlo thoughtfully. "Then the disaster would be magnified a millionfold."

"Right. It would split the Earth open like a clamshell. Yes, it would work, Carlo, but we don't even dare *think* of trying it." He stared off into the distance. "Still, it's basically a good idea. If we survive this it wouldn't be hard to rig up some sort of automatic spell to invert the antimatter in an emergency. Something like that should have been built in right at the beginning. Damn poor engineering." He looked up at Carlo. "Anyway, we have to live through this first."

"You have an idea?"

"Yes," said Layr grinning. "We're a spaceport, right? Let's act like one. I say we just lob that son of a devil clear into orbit, pentacles and all!"

"Of course. Why not?" Carlo grinned back. "It'll sure make a mess of the spaceport, though. We'll have to keep the pentacles intact; that means orbiting about half of power control with it."

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"True. But it'll make even more of a mess if it goes off."

Just as the suborbital entered the atmosphere over Italy, Ramsey heard an announcement. Naples port was closed to all incoming flights. Nobody would be allowed to leave the shuttle. They would pick up as many outgoing passengers as they could and boost out immediately. Naples was being evacuated. Ramsey cursed softly.

On the ground, Ramsey could see through the window that they were serious about the evacuation. Behind a rope barricade, a huge crowd milled about, waiting for a turn to board one of the suborbital transports, any one, just to get away from the city . . . and the volcano. A few policemen armed with electric stunners kept the evacuation from becoming disorderly.

Ramsey got up and walked nonchalantly down the aisle. One of the other passengers looked up at him inquisitively. "Just stretching my legs," he remarked casually. "Looks like we won't even get a chance to step outside." He stopped walking at a panel marked EMERGENCY EXIT. He looked around. Nobody else was paying any particular attention to him.

"TWIST KNOB. PULL HANDLE. REMOVE ALL SHARP OBJECTS FROM POCKETS BEFORE SLIDING DOWN CHUTE." Ramsey reached out and twisted and pulled in a single smooth motion. The emergency exit popped open and the escape slide inflated with a loud pop. Before any of the startled passengers could react, he scooped up the briefcase Kirschmeyer had given him and dove headfirst down the chute.

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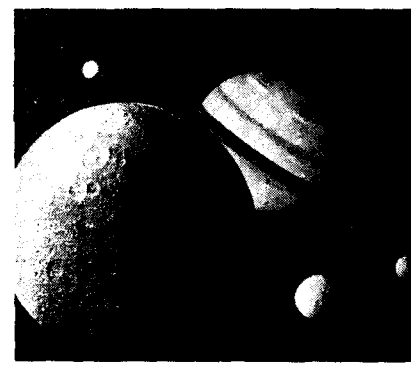

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One of the guards saw him just as he hit the ground. "Hey! *Non autorizzato*—" Ramsey dove into the mob, clutching the case firmly to his stomach, keeping his head down so his height and color wouldn't give him away. The guard started after him, but a second policeman grabbed the first and said something in rapid Italian. The first guard answered back, then shrugged his shoulders.

After all, they were trying to keep the evacuation orderly, not to keep people from coming in. If some crazy American walked into the danger zone voluntarily, what was it to them?

Once outside, Ramsey quickly discovered that he had three major problems. He couldn't speak Italian. Even if he could, no one would be willing to take him anywhere near Vesuvius, for any amount of money . . . and he had no money anyway.

Kirschmeyer should have thought of these things before sending me off, he thought. Damn cowardly fool. He could have at least arranged to let somebody know he was coming.

He walked over toward the entrance. The road leaving the 'port was empty; the one entering was jammed. Thousands of abandoned cars were parked over the sidewalks and overflowing into the plaza. Ramsey grinned. It had been a long time since the old days on the south side . . . but he figured he could still remember how to hotwire a car.

It was easy enough to find the volcano. A huge plume of black smoke, lit from below with a lurid red light, rose into the evening sky like a giant pillar. As he got closer, hot ash began to fall out of the air.

Ten miles away he was stopped by a roadblock. A policeman stepped out of a hastily-constructed shanty and shouted something in Italian, took a good look at Ramsey, then repeated it in English. "No passage! The road closed. Go back!"

"I've got to get through!" Ramsey shouted back. "Urgent! Important!"

"Road closed!" the policeman repeated. "Dangerous! No passage!"

He could go back until he was out of sight, Ramsey thought, then try cutting across the countryside.

"Ramsey! Ramsey, is that you?"

"Doctor Williamson! What on Earth are you doing here?"

"No time to explain. Where's Hans?"

"Not here. He sent me with some stuff." He held up Professor Kirschmeyer's briefcase.

"Good! Susan said he'd come through for her."

"Susan!" said Ramsey. "Where is she?"

Doctor Williamson pointed at the mountain. From here it was barely visible through the clouds of soot and ash. "There! See that outcropping, just below the lip? Just to the left of that."

"Gods!" said Ramsey. "How can she survive up there?"

"She's warded, naturally."

"Right," said Ramsey. "Can you get them to let me through to her?"

Doctor Williamson turned to the policeman and said something in Italian. The policeman went away for a moment and brought back another man, whom she also talked to. He raised the barri-

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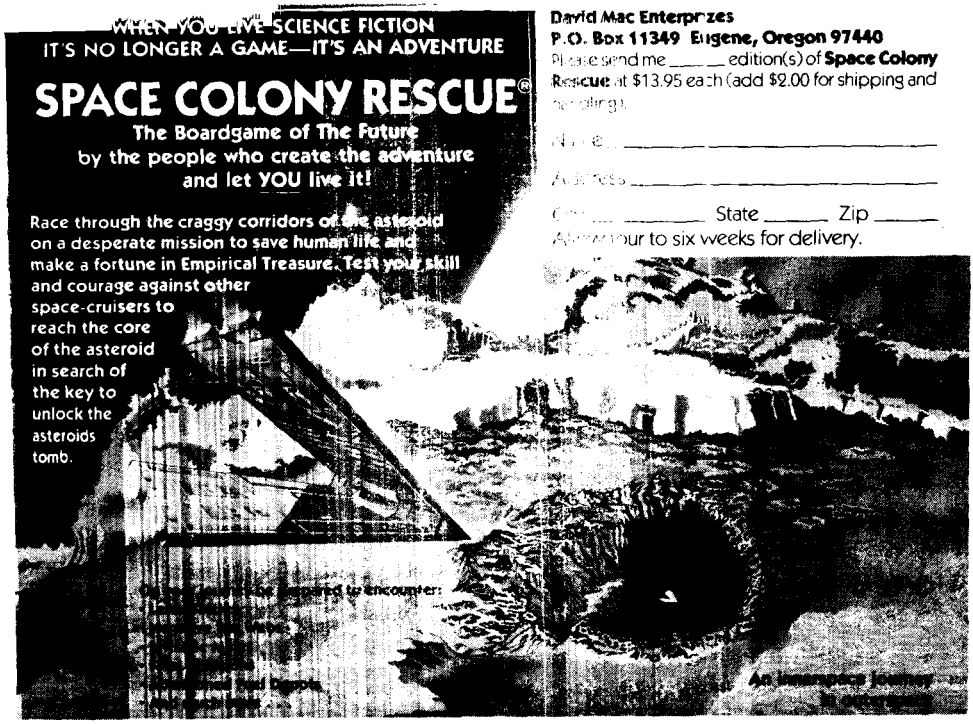
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cade and waved Ramsey through. "Better hurry," she said. "Good luck."

The drive up the volcano was like a drive through hell. Twisted trunks of burned trees loomed out of the clouds of ash like the souls of the damned. Red hot rocks whizzed out of the sky and smashed to earth all around him. He drove as fast as he dared through the strange murky twilight. A flying rock *zing!*ed off the hood. Close behind it came another, smashing into the windshield. Through the cracks the stench of sulfur suffused into the car.

Ahead he saw an island of relative calm. The eye of the storm? Eyes stinging, he headed for it. As he approached, he saw it was a pentacle. Susan was inside, making an invocation. Near the pentacle Ramsey saw the pitted ruin of an expensive sports car. He put his stolen car next to it, grabbed the briefcase, and dashed through the ash storm to the safety of the pentacle.

"Susan!"

"Ramsey! You made it!" Susan threw herself into his arms and kissed him. "Oh, Ramsey!" She looked around. "But where is Hans? Didn't he come?"

"No."

"No? *No?* Why not?"

Ramsey was strangely reluctant to tell her that Kirschmeyer had chickened out, headed for the exact opposite side of the globe. "Well, he, uh—"

"What?"

"When I left him he was headed for New Zealand," Ramsey said.

"New Zealand? Why—Oh, I see. So he doesn't think I can do it, huh? Thinks I can't calm it enough to stop the eruption. *Merde!* I wish he were here. I could sure use his touch."

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"He said you knew everything he did."

"Balderdash. I'm damn good, but he's still better. Well, I gotta make do with what I got, I guess. So, how long do we have?"

"Huh? Oh! The data!" Ramsey opened the briefcase. Under the pile of magical equipment were two microdisks. Susan picked them up and plugged them into the portable next to her. She looked at the display.

"Well. Not much time, is there? We'd better get to it!"

At Wellington 'port, Hans Kirschmeyer was trying to rent a vehicle. "Don't you have any hovercars? I have to travel over water."

"Sorry, all we have at the moment are wheelies. Try back in an hour."

"An hour? In an hour, we'll all be dead! Is there anywhere else? I'm desperate!"

"Maybe dockside."

At the dock Kirschmeyer found only one rental place open. The proprietor, a lean blond kid in a sheepskin jacket, leaned against the counter. WE RENT ANYTHING, said the sign.

"Got any hovercars I can rent?"

"Nope," the proprietor said.

"Aircraft? A seaplane, perhaps?"

"Nope."

"Motorboats?"

"Nope."

"Sailboat?"

"Nope."

"Well, what have you got?"

The proprietor nodded down at the water. "Rowboat."

Kirschmeyer looked down. A tiny skiff bobbed up and down in the swell. "I'll take it. How much?"

"You want it? She's yours."

"Thanks." Kirschmeyer threw in his bag, jumped in, and tossed off the mooring line.

" 'Course," continued the proprietor laconically, "she ain't got no oars. . . "

Kirschmeyer wasn't listening. He balanced in the boat, facing the rear and chanting, waving his hands wildly.

The rental proprietor leaned even farther over the counter to watch. Behind the skiff, a wave rose out of the sea, picked up the boat, and hurled it forward. For a moment it seemed as if Kirchmeyer would fall face first into the water. He finally caught his balance, and continued his chanting. As the boat disappeared over the horizon it was still accelerating.

Susan stood facing the volcano, speaking in a loud, commanding tone, occasionally glancing down at the portable console at her feet and scowling. Once Ramsey started to say something, but she gestured him to stay silent without ever breaking the cadence of her chant. Outside the tiny circle of calm, a nightmare scene of swirling black ash and streaks of orange flame writhed around them.

From out of the writhing ash, a deep, resonant voice seemed to speak unintelligible syllables in response to Susan's chants. Susan abruptly changed her chant, and made a new gesture with both hands. The voice got louder and deeper, almost turning into an inaudible subsonic rumble. Susan hit a key on the qwerty with her toe.

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"Got him," she remarked conversationally.

"*Naach forsitthanna quanne,*" stated the voice in a cold, dispassionate tone. Outside the pentacle, the whirling clouds of ash seemed to form into a shape. Not exactly a face, but an inhuman presence. Ramsey felt as if some giant pair of eyes were behind him, watching him with bored indifference.

"Naal tenepahh," Susan said in the same dispassionate tone. "Suumayeh anada. Tiirata na! Sooranala na! Tiir!"

"*Doonoro tiir,*" the presence said. "*Na ksissith, doon.*" Outside, flames shot up and swirled around the pentacle.

"Nadillil nabokikok," said Susan, and made a gesture. Deep violet flame shot from her hands and circled the pentacle.

"*Doon,*" said the presence. The violet flame vanished. "*Toorah.*" A sheet of deep orange flame formed around the pentacle and began to constrict. Susan waved one hand casually. The orange flame vanished.

"We're pretty evenly matched," Susan said to Ramsey. "So far I can't drive him back, but neither can he destroy me."

"What then?"

"Niiratah doowl," said Susan. "Kirilak!"

"*Doon, sibborkah,*" replied the low voice dispassionately.

"Sims na nabolith," she said. "Damn. That didn't work either. Kirschmeyer was right. I don't quite have the control or the power to hold it. Almost, but not quite."

"What now?"

"It's going to erupt somewhere," she said calmly. "I don't have the power to hold that back. Not for long, anyway. But right now I still have a little control over exactly *where* it will erupt."

Suddenly Ramsey got it. "You mean, you can make the eruption happen somewhere else? Where there aren't any people? Like, say, the middle of the Pacific? Or, maybe, New Zealand?"

"Yeah. Something like that. Only I can't make it happen exactly anywhere. What I can do, though, is invert the eruption exactly. Make the eruption happen at exactly the other side of the Earth."

"Which is?"

"I checked it on the computer before we started. About 500 kilometers east, and maybe a hundred north, of the Chatham Islands. In the middle of the ocean. Off New Zealand."

"Where Professor Kirschmeyer is waiting to handle it."

"So I hope."

She raised both hands over her head, and this time her voice was strong and confident. "SIBBOLAH! DIIRATAH! KAARANATATH NA TIIR! RAMANAH!"

She made a final, sweeping gesture.

"*Tiir.*" The voice died away into a gentle sigh, almost too low to hear. Outside the pentacle, the ashes swirled up once again, then began to settle. In moments the sky was clear.

Susan slumped down and gave a sigh of relief. "It's over."

Far to the south, there was a sudden flash of light. A tiny speck of fire hurled into the night sky, chased by a bolt of brilliant violet lightning. A moment later they heard the thunderclap. Ramsey jumped.

"What in the hell was that?"

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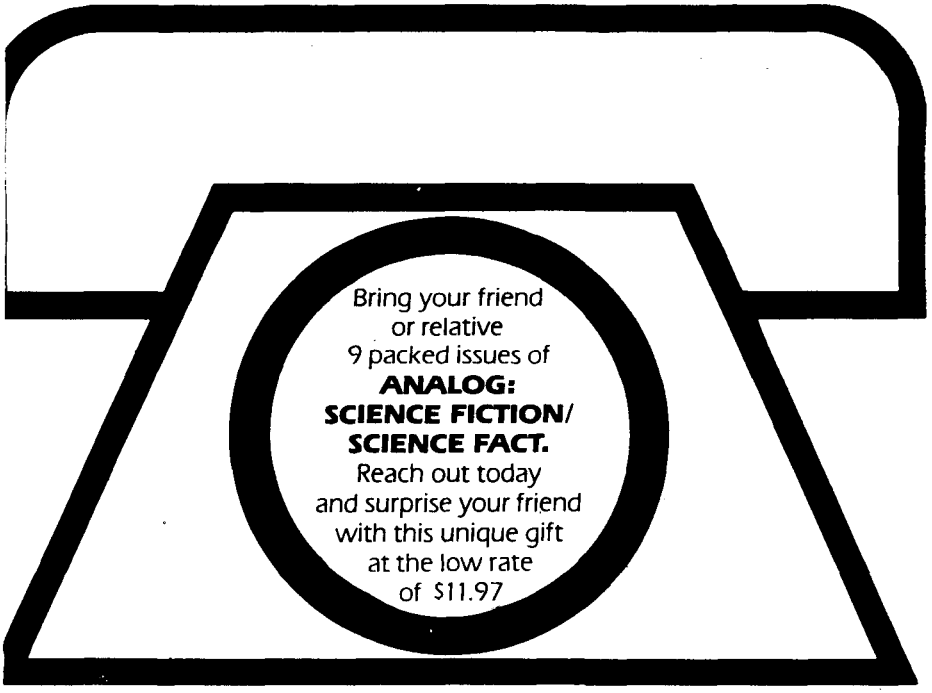

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Susan looked south speculatively. "The spaceport. That must have been the spaceport. They couldn't know we would be able to stop the eruption. I'd say that they just jettisoned their anti-matter pile, to protect the city in case we failed, in case the volcano blew."

"A little late, weren't they?"

Susan looked at her watch. "No. They had another ten seconds left. Ten seconds until it would have blown."

Five hundred kilometers from any land, on a tiny rowboat alone in the midst of the south Pacific, Hans Kirschmeyer felt strangely at home. He had no way to draw a pentacle, and no need. The ocean elemental he thought of as his friend, a friend he knew so well that they had no need for words.

Intellectually, he knew, that was complete nonsense. Elementals are forces of nature; they have friends no more than do the wind and the stars. But who says the wind and stars do not have friends? He looked at his watch and stood up in the boat.

"Ksirrith, Kisirrith na diir, my friend," he said. "Na naratah na diir for me, old friend. Diiratha, tegah! Naboleth, tegah! Diiratah!"

He looked at his watch again. Soon, soon. There was no way to stop the coming eruption. He wasn't even going to try. In mid ocean, he knew, a sudden volcanic eruption would be a much worse disaster than one on land. Instead of blowing away air, the shock wave would raise a great wall of water, a tidal wave, which could roll across a thousand miles of ocean as easily as across a bathtub, and still smash cities like toys. Still, he wasn't worried. He couldn't stop the eruption. But he could make his friend, the ocean elemental, ready for it.

He looked at his watch one final time. "Now," he whispered softly.

In the distance, a massive dome of water lifted into the air, fragmented into a thousand gargantuan droplets, and started to fall slowly back to earth. From below shot out a bright plume of fire, reaching into the clear sky, followed slowly by a huge cloud of black ash.

Still there was no sound. He could see two waves, one traveling out from the gash in the ocean floor, the other traveling inward to fill in the place splashed dry by the eruption. When the wave hit the plume of fire, a cloud of purest white rose into the air, challenging the cloud of black ash for dominion of the sky.

"Magnificent," he whispered softly.

The shock wave hit and almost bowled the tiny boat over. Hans fought to remain upright. He whispered a word to the elemental he thought of as his friend. The boat righted itself. The tidal wave loomed in front of him, ten, twenty, fifty feet tall. It picked up the boat like a piece of straw.

"Gently, gently, my friend," Hans murmured. "Nakonah nadoran, nakonah na diir. Calm, calm." The boat shot along like a board riding the crest of some surfer's fantasy. Hans smiled softly as another idea occured to him. He would calm the tidal wave, yes . . . everywhere except behind the boat. The proprietor of the rental place had looked surprised to see how he left. Just wait until he saw him return!

On top of the still smoking volcano,

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two twisted lumps of metal lay slowly cooling in the moonlight. Ramsey could no longer even tell which one had once been the sports car. He found a boulder that was cool enough to touch, brushed the volcanic ash off, and sat down. Susan came over and sat next to him.

"I guess I still don't understand why this . . . " he gestured across the devastated mountainside " . . . had to happen. You say it was just a few peasants trying to improve their crops?"

"Not a few. I don't know how many. Thousands, I'd guess. Maybe millions. Once one found a spell that worked, he told somebody else. It must have spread exponentially. Individually, none of them mattered. All of them together, well, together they woke up something none of them asked for."

"Just ignorant peasants . . . " said Ramsey.

"Ignorant? Not really. No more than you, or anybody who uses a technology without really understanding it, or its consequences. Only in this case the consequences turned out to be a little worse than just having a little snow dumped on their heads. They just happened to know the wrong spell, at the wrong time, and in the worst possible place."

They sat in silence for a while.

"Well, I suppose somebody will come for us sooner or later," Ramsey said at last. "Probably not for a while, though."

"Well, I don't think I'm in any hurry," said Susan. She smiled and looked across at him. "Are you?"

Ramsey looked back at her. Her hair was a tangled mess. Her dress was ripped and streaked with ash that had somehow managed to leak in past the ward. She was still trembling slightly, either with left-over fear or with exhaustion. She was the most beautiful thing he had ever seen. "I can't think of anybody I'd rather be marooned on top of a volcano with," he said. ■

● Scientific research is an entry into the endless, not a blind alley; solving one problem, a greater one enters our sight. One answer breeds a multitude of new questions; explanations are merely indications of greater puzzles. Everything hints at something that transcends it; the detail indicates the whole, the whole, its idea, the idea, its mysterious root. What appears to be a center is but a point on the periphery of another center. The totality of a thing is actual infinity.

Abraham J. Heschel

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Stephen L. Gillett, Ph.D.

SECOND PLANET—SECOND EARTH

As we all know by now, the Old Venus of Carboniferous jungles, or fetid swamps, or global seltzer seas does not exist. The New—and unfortunately real—Venus, brought to us by spacecraft and remote sensing over the last 20 years, hardly needs review: We all know about the heavy, suffocating blanket of carbon dioxide, halfway between an atmosphere and an ocean, that envelopes the planet; the surface temperatures in excess of 400°C; the complete absence of liquid water and the near absence of water vapor, and the slow, retrograde rotation . . . *Sic transit gloria mundi!*

As the probability—and then the certainty—of ferociously hostile conditions on Venus began to sink into the SF community, a new SF dogma has arisen: the terraforming of Venus. If the planet is not Earthlike now, well, we'll make it so! A number of stories over the years (starting, probably, with Poul Anderson's "Big Rain" in 1955) have touched on the problem of terraforming Venus, either as a major element in the story or as an aside. In the sixties, Carl Sagan lent the notion some scientific respectability by speculating that the introduction of algae into the upper Venusian atmosphere would begin breaking down the CO_2 by photosynthesis. As this process continued, the trapping of solar heat

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would become less efficient, the surface temperatures would drop, and rain would eventually fall—*voilà*, Nova Terra! Since Sagan's original exposition, a number of enthusiasts have championed this idea. Most recently, James Oberg has written an entire book on terraforming, devoting a whole chapter to Venus.

Just how hard will it be to terraform Venus? Well, to pre-empt my punchline now, it will be very difficult; far more is involved than simply squirting some algae into the atmosphere and waiting to set up the land offices. There is so much CO_2, and so little water, that some major transfers of material from elsewhere in the Solar System are indicated. In this article, I'll investigate in detail just how difficult the terraforming of Venus will be. We now know enough about Venus itself, including the composition, mass, and dynamic behavior of its atmosphere, the gross surface topography, and even a couple of surface analyses, to sketch out with some confidence what needs to be done.

Let's review the problems beforehand to set the sheer quantities involved in perspective. Table 1 lists the relevant data for both Earth and Venus, including the probable complement of some important volatiles (compounds that are generally concentrated in the atmosphere or oceans). Total volatiles are expressed both as kilograms, and as kilograms per square centimeter of planetary surface. We'll find this latter expression to be the most useful because Venus' area is about 10% less than Earth's. As with fertilizer, the amount you need depends on the area to be covered!

Problem 1. Too Much Air

From Table 1, Venus has almost 100 *kilograms* of atmospheric CO_2 for every square centimeter of the planet's surface. That's a *lot*. If we assume all that CO_2 to be tied up as calcium or magnesium carbonates, we end up with a layer of carbonates more than 800 meters thick over the entire planet. Complete reaction of approximately the outermost 16 km of the Venusian crust would be necessary to remove all the CO_2 as carbonates. On Earth, reaction on this scale has occurred over geologic time, because plate tectonics continually—albeit slowly—churns Earth's crust. On Venus, though, we have neither the mechanism nor the time.

If, instead, we separate the CO_2 into C and O_2, we end up with a layer of carbon almost 150 m thick—a lot of soot!—and 73 kg of oxygen for every square centimeter. Having gotten that far, it would be very hard to keep the C and O_2 from recombining; that much carbon under that much oxygen would make a dandy fire. On Earth, a coal bed more than a meter or so thick can be expected to burn out to great depths when it becomes exposed at the surface. The Clinker Beds of the Powder River Basin, Wyoming, are cooked rock that was baked by miles of burning coal beds.

(If you're worried because Venus has more CO_2 and nitrogen than the Earth, don't be. The discrepancy is more apparent than real. It's hard to estimate the Earth's volatiles, because there are so many places to stash them, and most sources of error lead to underestimates. Also, a large but undetermined amount

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of Earth's volatiles probably reside in the upper mantle, due to their being carried down at subduction zones. The abundance of mantle volatiles, in fact, is now an active field of research, because they are now thought to be much more important in geologic processes than had been realized before plate tectonics.)

Problem 2. Too Little Water

Venus has very little water. The total amount in the atmosphere is somewhat uncertain, but it is apparently between 0.01% and 0.1% of the atmospheric CO_2; this would yield a layer between 4 and 40 cm deep over the entire planet. That ain't enough, not by a long shot. That's too little even for groundwater, because the regolith on Venus (the layer of broken and pulverized rock that results from meteorite impact, chemical and mechanical weathering, and similar processes, commonly but incorrectly termed "soil") is at least several meters thick, and it may well be much thicker. A few centimeters of water will drain out of sight! Further, under Earthlike conditions of low temperature and abundant water, hydrated minerals (minerals, like clays, that contain water in their structure) form ubiquitously, permanently binding up additional water. Finally, you can't have liquid water on the surface without also having some water vapor in the overlying atmosphere. Earth's atmosphere, the sort of thin, O_2-rich atmosphere we're aiming for, itself contains enough water vapor to cover the entire surface to several centimeters depth.

Problem 3. And It's Hot

Venus is way too hot—450°C melts lead. The high temperature results from the trapping of solar energy by what has come to be called the "greenhouse effect." Sunlight warms the surface, and the warmed surface reradiates the energy as infrared ("heat") radiation. However, the heat can't escape easily because the atmosphere is almost opaque to infrared wavelengths. The major contributor to the greenhouse effect is the CO_2, as you might expect, but crucial contributions are also made by the cloud particles (which are minute droplets of sulfuric acid) and by the miniscule amount of water vapor. (As an aside, the H_2O and CO_2 in Earth's atmosphere also yield a modest but significant greenhouse effect; they keep the surface warm enough for liquid water, and hence for life.)

Paradoxically, on the average less sunlight reaches the Venusian surface than the Earth's surface, although Venus receives about twice the sunlight Earth does (Table 1). This comes about because Venus reflects light more efficiently than Earth; that continuous cloud cover (actually, it's more like multiple levels of smog than terrestrial water clouds) reflects over 70% of all sunlight striking the planet. This effect will be a "Catch-22" that must be dealt with by the terraforming project: The clouds are significant contributors to the greenhouse effect, and thus help keep the surface hot; on the other hand, they reflect much sunlight that would otherwise also heat the surface.

Problem 4. The Runaway Greenhouse

This problem relates to the reason Venus arrived in its present sorry state to begin with. It may be very difficult

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to form and maintain liquid water on the surface at all, even with a light, Earthlike atmosphere. Why? Let me digress briefly to explain.

The liquid phase of any substance is not stable in isolation; liquid always coexists with a certain concentration of vapor. Chemically speaking, the "activity" of the liquid state must equal that in the vapor state. If the vapor activity is too low, liquid will tend to evaporate, and if it's too high, liquid will tend to condense. Equilibrium is said to exist when the activities of liquid and vapor are equal. The concentration of vapor that is in equilibrium with liquid (the "equilibrium partial pressure") rises with temperature; that's why you can dry things out by warming them. At yet higher temperatures, you finally reach the boiling point, which is simply the temperature beyond which no liquid at all is stable.

Now imagine a body of water on a planetary surface. At a given temperature, the atmosphere over this water contains an equilibrium partial pressure of water vapor. Raise the temperature slightly; some more water evaporates, and the partial pressure of H_2O over the water increases accordingly. But —because water vapor is a major contributor to the greenhouse effect, the additional water vapor makes the atmosphere somewhat better at retaining heat. So the temperature rises yet a bit more because of the heightened greenhouse effect; a little more water evaporates, which further increases the greenhouse effect, further raising the temperature —you get the idea. For temperatures not too far above the freezing point of water, like those on Earth, this process damps out, or "converges" (like compound interest) and a stable temperature and partial pressure result. As you might expect from Earth's huge oceans, its atmosphere is on the whole pretty close to containing the equilibrium partial pressure of water vapor. However, if temperatures begin just a bit higher, the process does not reach a limit; temperatures soar and the oceans boil. This is the runaway greenhouse.

Now, somebody's going to point out that as the equilibrium partial pressure rises with temperature, the boiling point also increases. (The boiling point of water, like that of any liquid, increases with pressure.) At the 90-odd atmospheres on Venus' surface the boiling point of water is roughly 290°C. Thus, it has been claimed that liquid water could form on Venus after the temperature has fallen only 160°C or so. Alas, although liquid water would certainly be handy to have on the surface as early as possible, the increased water vapor pressure would raise the efficiency of the greenhouse much more than it would raise the boiling point of water. The greenhouse still runs away.

The runaway greenhouse is probably the mechanism whereby Venus arrived at its present state. Calculations suggest that the additional solar heating received by Venus, because of its proximity to the Sun, was enough to initiate the runaway greenhouse early in the planet's history. In fact, it has been proposed that liquid water cannot exist at all on the Venusian surface, even under an initially light, Earthlike atmosphere, because of the runaway greenhouse effect.

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If oceans once boiled on Venus, why isn't water vapor one of the principal constituents of the present atmosphere? The water vapor was probably destroyed over geologic time by photodissociation. In this process, ultraviolet from the Sun splits water molecules in the upper atmosphere into hydrogen and oxygen atoms, and the hydrogen subsequently escapes because of its lightness. In fact, the hydrogen that does remain on Venus is greatly enriched in deuterium, the rare, heavy isotope of hydrogen, because the deuterium tended to be left behind. The oxygen was also left behind, and over the course of geologic time has been removed from the atmosphere by oxidation of crustal rocks. This leads to the corollary that the Venusian crust and atmosphere are probably highly oxidized. By the way, photodissociation also occurs in Earth's upper atmosphere, but at an extremely slow rate; the upper atmosphere of the Earth is cold enough to freeze out most of the water vapor before it gets high enough to be destroyed.

The runaway greenhouse must be circumvented somehow if Venus is to be terraformed successfully and permanently. It certainly wouldn't do to spend thousands of man-years removing the CO_2 atmosphere and cooling the surface, only to watch all the effort go for naught once water was finally imported. In fact, I feel that terraforming is a pointless exercise if the resulting planetary environment is not stable over a significant interval of geologic time—that is, stable for hundreds of millions of years, not merely for thousands of years.

What Can We Do?

So, terraforming Venus has three major problems that are interrelated via the runaway-greenhouse effect: There is too much air (of the wrong composition), there is not enough water, and the planet is too hot. I can imagine a spectrum of solutions ranging from brute force to finesse; in this article, I'll concentrate on the finesse solutions, because they are at or just beyond current technology. It may turn out that far-future technologies will be the most practical, but we can't talk intelligently about such technologies now. (I'm not going to worry about the slow rotation rate—that's a second-order problem, and my gut hunch is that it can be lived with.)

If oceans and an Earthlike atmosphere are intrinsically unstable on Venus, there's no point in pursuing the terraforming project. However, there seem to be two possible ways to circumvent the runaway greenhouse, short of moving the planet farther from the Sun, which seems too far beyond current technology to consider now. Both approaches are not mutually exclusive, and indeed will be employed together.

Brine and the Runaway Greenhouse

First, we do *not* want to have a terrestrial ocean's worth of water on Venus. Once that CO_2 blanket is thinned down, the temperature of the Venusian surface will not be uniform; the equator will be warmer than the poles, and the highlands will be cooler than the lowlands. If we introduce only a modest amount of water onto Venus, although the water might evaporate in the hot re-

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gions it would precipitate again in the cooler areas. Evaporation can never fully enshroud the planet in a vapor blanket because there isn't enough water. The greenhouse does not have the wherewithal to run away.

Second, we want very salty oceans. The runaway-greenhouse calculations were performed using the thermodynamic constants for pure water. The equilibrium partial pressure over brine, however, is less than over pure water; in fact the activity of water in a highly concentrated brine such as the Great Salt Lake or the Dead Sea is only a little more than 50% of the activity of pure water at the same temperature. (You can think of the salts in the brine as holding on to the water molecules, so that they escape into vapor less easily.) The low activity of the liquid lowers the equilibrium partial pressure of the vapor correspondingly. This effect by itself may be enough to stablize open bodies of liquid water on the Venusian surface.

Salty oceans may come about automatically as a result of the terraforming. Venus has probably about the same amount of chlorine as Earth—as we've seen, their complements of other volatile elements look to be similar, even including hydrogen if Venus really had much water originally but has lost it through photodissociation. A small amount of HCl occurs in the Venusian atmosphere (Table 1), and this is consistent with the presence of much larger quantities of chloride salts on the surface. Probably, therefore, there are lots of chloride salts on or near the Venusian surface just waiting to be dissolved. (Chloride is the most abundant anion [negatively charged ion] in Earth's oceans. In fact, over 80% of Earth's chlorine is present as chloride in the oceans, and most of the rest of the chlorine is chloride that has been mechanically sequestered from the ocean either as entrapped water in sedimentary rocks, or in salt deposits resulting from evaporation.)

Sulfate ion ($SO_4^=$) is the next most common anion in terrestrial seawater, and it is also abundant in certain saline lakes, such as the Great Salt Lake. Sulfate is likely to be common on Venus as well, because of the highly oxidized conditions I've mentioned. Most sulfur on or near Venus' surface will have been oxidized to sulfate. In fact, the droplets that make up the clouds are mostly sulfuric acid.

Finally, carbonate ($CO^=_3$) and bicarbonate (HCO^-_3) ions are important in some saline lakes on Earth, and they will be important on Venus from dissolving residual CO_2 according to the following reactions:

$$H_2O + CO_2 = H^+ + HCO^-_3 = 2H^+ + CO^=_3$$

(You chemists in the audience will have noticed that I'm emphasizing just the anions in talking about what makes the seas salty. I do this because it is the anions that determine how many water-soluble salts are available. For example, we all know that sea salt is mostly sodium chloride, ordinary table salt. However, although most of the Earth's chlorine is in seawater, or was once in seawater, only a small percentage of Earth's sodium is in seawater. Much more occurs combined with oxygen in

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Table 1.	Earth	Venus
Orbital Elements		
Mean distance from Sun (Millions of kilometers)	149.6	108.2
Orbital Period (year), in days	365.265	244.701
Bulk Constants		
Solar constant, joules/cm²/sec	0.134	0.256
Sidereal rotation period	23.9345 hours	243.01 days
Solar day (Mean interval between sunrises)	24.0000 hours	116.75 days
Mean radius, kilometers	6371	6051
Mass, kilograms	5.976×10^{24}	4.870×10^{24}
Density, grams/cubic centimeter	5.52	5.25
Surface gravity, m/sec²	9.83	8.87
Escape velocity, km/sec	11.2	10.4
Surface area (Millions of square kilometers)	510.6	460.1
Mean surface temperature	15°C	457°C
Partial volatile inventory (all in units of 10^{17} kilograms)		
Total CO_2 equivalent*:		
atmosphere	0.025	4600
ocean	1.4	N/A
crust	2400 (mostly carbonates)	? (prob. small)
Total	2400 (47.0 kg/cm²)	4600 (99.4 kg/cm²)
Total water:		
atmosphere	0.17	0.19–1.9
ocean	14000	N/A
crust	1900	?
Total	16000 (3.13 kg/cm²)	0.19–1.9 (4.2-42 g/cm²)
Total nitrogen:		
atmosphere	38.7	106
ocean	0.2	N/A
crust	10	? (prob. v. small)
Total	49 (0.96 kg/cm²)	106 (2.3 kg/cm²)
Total chlorine:		
atmosphere	very small	0.000004
ocean	262	N/A
crust	50	? (probably large)
Total	312 (6.1 kg/cm²)	? (probably similar to Earth)

*The total CO_2 that would result if *all* carbon were carbon dioxide

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crustal rocks, and those rocks don't dissolve.)

Given this likely abundance of water-soluble salts, briny seas will be an immediate consequence of importing modest quantities of water to Venus. Shallow, salty oceans are the image of the "newborn seas of Venus!" At least the requirement to import minimum quantities of water will ease the logistics of the terraforming project. It's nice to have *something* turn out to be a little easier!

Removing the Air

It looks as though we can avoid the runaway greenhouse by the strategies above. Therefore, let's turn our attention to thinning down the atmosphere, cooling the surface, and bringing in the water.

One possible way to thin the atmosphere is to remove it bodily. However, that seems like the hard way. To remove 4.6×10^{20} kg of CO_2 in, say, 100 years requires moving 150 million tons every second. Lifting all that mass out of Venus' gravitational well also requires a prodigious amount of energy, some 2.5×10^{28} joules, or about 6×10^{12} megatons. Additionally, it's probably not practical to split the CO_2 into C and O_2 first and then just remove the oxygen. Although only about two-thirds as much mass would need to be lifted, keeping the oxygen and carbon separated in the meantime, or alternatively filtering out the oxygen as soon as it's formed, look to be formidable problems.

Perhaps instead we could boil the atmosphere away, heating and photodissociating the carbon dioxide by concentrating sunlight with vast solar mirrors. Hydrogen was lost initially by photodissociation from ambient sunlight; surely we could force heavier gases to escape with concentrated sunlight? Maybe. But the efficiency of thermal escape decreases very rapidly for heavier atoms; for carbon dioxide molecules to escape as efficiently as hydrogen atoms escaped, the temperature must be thousands of degrees Kelvin. Even oxygen atoms (which the CO_2 will partly dissociate into) need similar temperatures to escape efficiently; after all, we can't wait for geologic time. In addition, heating the carbon dioxide requires not only an intensive energy source, but also highly efficient *absorbtion* of the energy by the gas. If most of the sunlight just passes through, it doesn't do much good. Moreover, the absorbtion must occur at the edge of the atmoshpere, where it is thinning into space, so that fast-moving molecules have room to escape. Molecules deep in the atmosphere, however much thermal energy they possess, are prevented from escaping by collisions with their neighbors.

Boiling off the atmosphere may work, but it will require much more sophisticated analysis than I can give in an article like this one. In any case, it seems that other ways for removing the carbon dioxide, besides lifting it off the planet, are also worth investigating (although the invention of antigravity could change this assessment drastically!)

Can we lock up the CO_2 as carbonates in crustal rocks, as has happened on Earth over geologic time? This approach

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seems promising, but it is still beset with problems from the sheer volume of atmosphere. First, the rock that's currently on the surface isn't going to be much help. If we assume a regolith 10 m thick, and assume that it is composed of about 15% calcium and magnesium by weight (this proportion is suggested by the Venera surface analyses, and in any case is reasonable for common igneous rocks), only about 1 kg/cm^2 would be removed if *all* the calcium and magnesium in the regolith react completely. Quick or complete reaction is not reasonable, because the calcium and magnesium are already combined in silicates that must be broken up. In addition, the present surface temperatures on Venus are too high for carbonates to be stable (or, at the least, the carbonate is in chemical equilibrium with some silicate). We have to lower the temperature to remove CO_2 as carbonate, but we can't lower the temperature until the CO_2 is removed. Another Catch-22!

Possibly we can thin the Venusian atmosphere by reacting it with additional material from elsewhere in the Solar System. If we split all the CO_2 into C and O_2 (say by means of algal activity), we end up with an enormous amount of excess oxygen that must be gotten rid of. Fortunately, because it is highly reactive, oxygen will be easy to precipitate out of the atmosphere by combining it with other elements.

Turning Air into Sea

One possible way of disposing of all that oxygen is to react it with hydrogen imported from off-planet. This also would solve the water-importing problem. If all the O_2 that is currently bound in atmospheric CO_2 were converted into water, which requires about 4×10^{19} kg of H_2, 81 kg/cm^2 of water result. This corresponds to a mean depth of over 800 m over the entire planet. That's only about 30% of the volume of Earth's oceans, but is still a respectable quantity of water.

In fact, given our concerns about avoiding a new runaway greenhouse, that is probably too much water. Seas only about 10% of the volume of Earth's would be saturated with respect to salt, if they contained the same amount of sodium chloride. Therefore, rather than import 4×10^{19} kg of hydrogen, we can get by with perhaps 10^{18}kg.

Where can we get some hydrogen? Unfortunately, the boiling point of elemental H_2 is so low (20°K) that it probably does not occur uncombined on small, volatile-rich, easy-to-move-around bodies such as comets. The hydrogen-bearing compounds that do exist (methane, CH_4; ammonia, NH_3; and H_2O itself) are much less useful than pure H_2, because the additional elements that are brought along, such as the carbon in methane, add to our problems.

One possible source of elemental hydrogen that comes to mind is the solar wind, the extremely low-density, high-velocity plasma continually streaming from the Sun. The flux of protons (hydrogen nuclei) in the solar wind at the distance of Venus fluctuates around an average of 10^9 atoms per square centimeter. That sounds like a lot; surely we can focus some of the solar wind on Venus and bring in hydrogen that way?

Unfortunately, atoms are so small and

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planets so big that a billion atoms per square centimeter per second is still inconsequential. The 10^{19} kg of hydrogen required corresponds to about 10^{46} atoms. Imagine channeling all the solar wind that passes through an area 10^6 km on a side (about three times the distance from Earth to Moon!) onto Venus with 100% efficiency, perhaps with a gigantic magnetic funnel. To put 10^{46} atoms on the planet still takes on the order of 100 million years. Perhaps hydrogen could be transferred directly somehow from the Sun to Venus; again, however, that sort of thing seems too far down the pike to consider seriously now.

Another possible source of hydrogen, proposed by Jim Oberg, is to import it from one of the outer planets, possibly Saturn. The major disadvantage of this idea, of course, is the energy needed to purify and bring an enormous quantity of material out of a deep gravitational well. We've already discussed this kind of problem in connection with removing Venus' atmosphere; at least hydrogen's a lighter gas, and we need to move less of it. Further, most of the mass of the water molecule—89%—is in the oxygen, so that things are only one-tenth as bad as they would be if water itself needed to be brought in. Still, if we want to bring in 10^{19} kg of hydrogen in 100 years, we have to move 3 million tons of hydrogen every second. Saturn may yet turn out to be the most convenient hydrogen source, but it's worth looking elsewhere first.

Pluto may be cold enough to retain liquid or solid H_2 on the surface near the poles. Recent results have shown Pluto to have a low density, typical of an icy body, and this low density also leads to a modest escape velocity. Automated surface mining on Pluto, with mass drivers to catapult hydrogen off the surface, may be a relatively cheap way of obtaining gigatons of H_2. Wanna go prospecting, anyone?

Disposing of Excess Oxygen

After the hydrogen is imported, 2.5×10^{20} kg of O_2, corresponding to 3.5×10^{20} kg of CO_2, must still be gotten rid of. The most promising method of disposal is to react the oxygen with a metallic element to form a solid oxide, which will then plummet to the surface. One possibility is to introduce calcium or magnesium; these metals rapidly react with oxygen to form oxides:

$$2Ca + O_2 = 2\,CaO$$
$$2\,Mg + O_2 = 2\,MgO.$$

Subsequently, these oxides react with CO_2 itself to yield carbonates directly:

$$CaO + CO_2 = CaCO_3.$$
$$MgO + CO_2 = MgCO_3.$$

Thus, less CO_2 needs to be split—a "twofer special!"

Unfortunately, both calcium and magnesium are very reactive and do not occur, so far as we know, uncombined in the Solar System. Instead, both are tightly bound in silicate minerals. Calcium minerals are rare in meteorites (and thus probably in asteroids) but the mineral anorthite ($CaAl_2Si_2O_8$) is common in parts of the Moon. Magnesium is common both in meteorites and on the Moon in the mineral olivine, Mg_2SiO_4. To refine metal from these silicates is difficult; further, the amount of metal required for Venus' atmosphere

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is awesome, some 6.3×10^{20} kg of calcium or 3.8×10^{20} kg of magnesium.

A more "quick and dirty" and probably more practical oxygen scavenger is iron metal. Unlike calcium and magnesium, native iron (the free metal) is abundant in the Solar System. It occurs in iron meteorites, which are largely composed of nickel-bearing iron. As all we Earthlings know, iron reacts readily with oxygen, in the presence of water, to yield an assortment of orange, flaky hydroxides and oxyhydroxides (that's spelled "rust"!). These compounds dehydrate over time to yield ferric oxide, Fe_2O_3, the mineral hematite. (Hematite is bright red, and is the pigment that makes much spectacular scenery in the southwestern USA.) Hematite won't react further with CO_2 to yield carbonates as will the calcium or magnesium oxides. Despite this, however, free(!) iron is so abundant that economics will almost certainly dictate its use as the main oxygen scavenger.

All the dirt that results from binding up Venus' atmosphere, this mixture of elemental carbon, metallic oxides, and perhaps carbonates, adds up to a mean thickness of hundreds of meters over the entire planet. Will there be room for all this material on the planet's surface without leveling it smooth? After all, we're going to need basins for those shallow seas.

Fortunately, although Venus is smoother on the average than the Earth, the planet does have significant relief, as shown by the radar altimeter on Pioneer Venus. The general topographic relief is known for about 93% of the surface. Only the area immediately surrounding the poles hasn't been mapped. Two highland areas, Australia-sized Ishtar Terra in the north and Africa-sized Aphrodite Terra in the equatorial regions, each stand from two to over nine kilometers above the mean surface level. There are also several smaller highlands elsewhere. On this basis, there's plenty of room for a kilometer or so of fill dirt in the lowland areas. Further, the highlands will be the best places for settlement. They're cooler, and rain will fall there to form freshwater rivers and lakes.

Bringing It All Together

In the light of the above discussion, the scenario for terraforming Venus will look something like this. First, in the step that has become traditional, we will introduce hardy algae into the clouds to begin breaking down the CO_2 and releasing oxygen. Algae that are carried too far down into the atmosphere will be charred to carbon, releasing water back into the atmosphere while the carbon is deposited on the surface far below. Meanwhile, elemental hydrogen will be brought in to react with the oxygen. The additional water formed helps maintain the clouds and thus the high reflectivity of the planet, and in addition the new water should foster the growth of more algae.

We'll have to be careful, however, about making too much water all at once and increasing the greenhouse effect. Further, oxygen can't be allowed to become too abundant during the terraforming, or it will burn the carbon accumulating on the surface. That just re-creates the CO_2. Therefore, raw metal, proba-

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bly iron, will also be continually introduced to scavenge the excess oxygen. After thousands of man-years of effort, the Big Rain will finally fall—first tentatively, at the poles and in the highlands, but water will eventually accumulate at the surface and the clouds will slowly clear.

How long will it take? At least a century will probably be required to bring in all the material needed. A minimum time for the terraforming can also be estimated in another way. If we assume that all the sunlight intercepted by Venus is used by algae to split CO_2 molecules with 100% efficiency, the time required is on the order of 400 years. With more realistic efficiencies the time goes up accordingly. The project will also have to be orchestrated very finely over the years, because the timing of the activities is as important as the activities themselves.

Such a project obviously requires a very long-term commitment. The terraforming of a planet is a vast reclamation project. Even with such productivity aids as self-replicating robots, the project will need the economic resources of a huge entity, perhaps a consortium comprising the entire Earth. (The space colonies may be involved as well, but they might not be interested in planetary surfaces by then.)

Second Earth

And after perhaps centuries of effort, what has resulted? Large parts of Venus will be covered with shallow seas of concentrated brine suitable only for algae and brine shrimp. The lowlands above water level will be saline playas or rocky deserts, either of which will make the Sahara look benign. Hot springs will be ubiquitous; while near-surface rocks will cool off rapidly, rock is a good thermal insulator, and the thermal gradients within the Venusian crust will remain elevated for millenia. (Although, come to think of it, that's an obvious source of cheap and abundant geothermal power!) On the highlands, however, and perhaps in polar lowlands as well, fresh water will run and climate will be temperate. Rain, after all, is fresh even when evaporated from concentrated brine. Continent-sized parts of the Venusian surface might be very pleasant places indeed for unprotected human beings.

On the whole, though, the picture doesn't sound as Earthlike as one might perhaps wish. And yet there are other considerations. For one thing, most of the Earth isn't habitable, either; 71% of the surface is covered with dilute brine, and a major portion of the rest is desert, or tundra, or ice cap, or some other less-than-congenial environment. Virtually all of humanity makes do quite happily on less than 10% of the total surface area of the planet. By these standards, a worthwhile fraction of Venus will be habitable by human beings.

More importantly, though, the entire Earth is teeming with life in endless variety in diverse settings. As humans, we really have a very parochial view of what "habitable" means, even on our very own home world. We can't even drink the seawater on our Earth! In terraforming Venus, we will have created a host of environments which, although perhaps not comfortable for humans,

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will thrive with Earthly life.

For example, at first the salty Venusian seas will certainly be filled with little besides algae and brine shrimp (I suspect, though, that they will be happy enough!) But as evolution operates, more complex ecologies will eventually emerge. To analogize: Terrestrial marine life is abundant because "normal marine salinity" (an accident of the ratio of chlorine to water on the Earth) is ubiquitous, and has been so over most of Earth's history. Life adapted to concentrated, briny oceans like those proposed for Venus is rare on the Earth because those environments are rare and geologically ephemeral. Were they common and long-lived, life adapted to them would be abundant. It is an ecologic truism that common environments are inhabited by a large number of diverse species, with no one species being represented by very many individuals. In contrast, rare environments are inhabited by a very few, highly specialized species, although each species is represented by a huge number of individuals.

Herein, to me, lies the entire justification for terraforming: We are not "just" making a planet suitable for human habitation, we are making it suitable for entire diverse, disparate ecologies of terrestrial life! Many of these ecologies, such as the marine ones, will exist independently of us even when we're living on the planet. Further, we will have established planetary environments that are stable over geologic time—hundreds of millions of years, not merely the thousands of years that human history reckons as a "long time." Unlike space colonies, say, these environments do not depend on human maintenance and hence on the continuation of technical civilization. If humanity should blow itself up, or if an asteroid should smite the Earth—it's happened before, and will happen again—entire ecologies, not merely the hardiest, will survive. Whatever befalls humanity, evolution has an opportunity to work out an alternate destiny.

Terraforming Venus gives a second chance—not just for human beings, but for all of the Earthly life.

It seems to be worth it. ■

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Jay Kay Klein's biolog

Just about everything printed in English this past century has been typed on a keyboard designed to slow the typist down. Some fifty years ago the Dvorak keyboard was devised to increase typing speed upwards of fifty percent, but I've only known two people ever to have switched. One is Lester Del Rey, an old-time *Analog* author who years back moved and resoldered each letter of his typewriter. The second is Stephen L. Gillett, who reprogrammed his word processing computers. The hard part was reprogramming his synapses.

This devotion to sheer scientific logic marks Steve's career as geologist and article writer. He was raised literally with the atomic bomb on his doorstep, since his father is with the major support contractor at the Nevada Test Site. Bachelor and Master degrees in Geology came from Caltech and a Ph.D. from the State University of New York at Stony Brook.

When it comes to fiction, predictably he likes "hard" *Analog*-style stories. He has noticed, though, that there are a lot of fantastically interesting phenomena and technological developments that would be naturals for science fiction, which never make it into stories. He loves to bring them to the attention of the rest of us through articles. For example, everyone's heard of giant meteroite impacts. But what about giant ignimbrite eruptions? Steve feels these had as much effect on the evolution of land life as the meteorites and were just as catastrophic.

Steve spent two years with the U.S. Geological Survey at their Paleomagnetics Laboratory in Flagstaff, then later worked for a small geophysical firm in the Seattle area, where he lives now, before deciding to go on his own as a consulting geologist and computer programmer. One of his more recent jobs was setting up a paleomagnetics lab for a major oil company. This included interfacing a state-of-the-art magnetometer with an IBM PC.

"Geology is a great science for keeping an overview of science in general. You need to know a fair amount of chemistry and physics and a generous smattering of biology; even astronomy is now part of the background because with the onslaught of data during the Space Age, study of other planets has edged into geology." This all adds up to a need for the human mind to synthesize huge amounts of information into a system for understanding the Earth and the other planets. In evidence of his interests, he is just concluding a term as a regional director of the L-5 Society.

Back home with his veterinarian wife, he often gets behind the family piano to belt out ragtime. With a schedule pretty heavily booked, he is not often found at science fiction conventions, but was recently Scientist Guest of Honor at the MosCon in Moscow, Idaho. His writing is done in bits and pieces as he has time. ■

Stephen L. Gillett

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Probability Zero

CENTURY OF PROGRESS

Jay Kay Klein

He looked at the face smiling hopefully before him. Mr. William Brown of the Royal College of Barbers and Surgeons had flown in from London that morning expressly to consult face to face with the patient. A freckled face it was, belonging to an ordinary young man of just twenty-four, unremarkable in any obvious way and surmounted by a mop of hair obviously combed into an unaccustomed neatness by someone else. Obviously, because beneath the patient's chin was an inch or so of neck that was sticking out of a rectangular life-support box on a low table.

About a half-cubic meter in volume Brown estimated, and his knowledgable eyes scanned the row of telltales—all safely LED green. No yellow and certainly no red transforms of the solid circuit indicators. Qualitative indicators normal, too, with quivering dial pointers representing second-to-second parameters dead-centered in optimum ranges.

"Well, we've come a long way," he said to the patient, more in an attempt to put him at ease than to convey information.

"Oh, yes—I was sure I was a gonner when I fell into the food processor at the plant," the head answered, it's mouth articulating the circuit-generated and modulated air vibrations from within the box. "I can remember it like it was yesterday, the knives slicing off my legs and then—"

He was interrupted. "No use thinking about it, son," the surgeon said. "We'd just better get on with the business at hand." He almost added "so to speak" but

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refrained. "Look, I'm really supposed to have a written okay, but I've been told the recorder here"—he patted a much smaller box on the table—"will furnish voice prints acceptable to American law and, more important, your American hospital."

The patient understood what was wanted, and said he'd be happy and eager to try the new surgical procedure if there was any chance at all, and yes, he understood it was experimental in nature, not having been performed on humans before.

And so it was that medical history occurred when a young American was wheeled into the operating theater of a Boston teaching hospital. A board-certified vitologist stablized the patient as the circuits of the support system, its LEDs now all crimson, were paralleled by a much larger and more complex theater machine, preliminary to detaching the patient's head. Brown peered through his bubble with its sterile air system intaking and exhausting through a small belt-mounted pack at his back. He signaled "all-go" to the team around him, and set to work with scalpel, neuro micro-manipulators, and an assembly of tissue materials.

Four hours later, the head was sentient again, lying on a pillow and attached to what was, even beneath a hospital sheet, a living body. "Oh, Doc," he said, "I can feel my arms and legs again, and it's like a miracle! I was sure I was stuck in that box for the rest of my life even if I'd live for a hundred years."

"Better call me 'mister,' son—my fellow barbers and surgeons back home wouldn't want me to think I'm getting above my station and thinking of opening practice in Harley Street. Speaking of home, I'll be leaving in a few minutes. Have a taxi waiting for me to get to the airport. I'll be just in time for dinner, and then a scan of the day's medical literature on the datanet. Never can guess what you'll run into. That's how I got onto your case, you know—the procedure I used was developed yesterday."

He leaned over the patient and felt through the sheet for a last-minute check. "Muscle tone seems just fine. Good organ stock here in the United States. You should be out of heré in a few days."

"Just a few days! And to think last week when I woke up in my box in the hospital I was told I was lucky just to be alive."

"Well, you know how it is these days," Brown said, "we made more progress last week than in all the recorded centuries of history before." ■

● If the lesser mind could measure the greater as a footrule can measure a pyramid, there would be finality in universal suffrage. As it is, the political problem remains unsolved.

George Bernard Shaw

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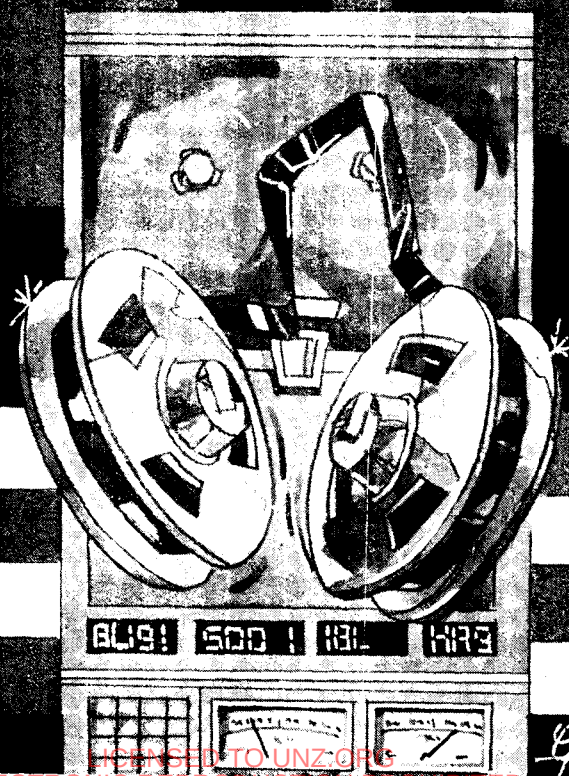
Frederik Pohl

CRITICALITY

There are students who live for Grades, and who get good ones, without ever getting a problem completely right. Is this the beginning of a trend?



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The night I met Arne Kastle the computer dating service had turned up a tall blonde named Marian for me. We flipped a coin to decide who decided where to go. I won. That is, I got the privilege of making the decision. I know there are some people who would look at that a different way. They would figure that if you don't make the decision you aren't to blame if it turns out bad, so that winning that toss is actually a kind of loss. I don't agree. As I see it, you look better if you're the one that takes the initiative. Anyway, I had made my mind up ahead of time that I would choose going to the Tom-a-Hawk Inn in Coney Island, and I'd been there often enough before to feel pretty sure it would score high with her. I was at least partly right. "That's a good nine for originality," she conceded, tapping her lower lip thoughtfully. "But I don't know about convenience. I'd say only a three."

"It's a long trip," I agreed and added that she was close to losing a point for grooming, since she had smudged her lipstick. That was risky. It's the sort of thing that can antagonize them, but I knew I was a certain ten for grooming anyway. I'd spent an hour with the hair blower and the cuticle sticks and everything else, and if she tried to downrate me on any of that she'd just make a fool of herself.

So, feeling satisfied with the way the opening gambits had gone, I handed her through the turnstiles and we took the long train ride through Brooklyn. Apart from the bothersome showing of papers at the checkpoints at the tunnel and Fort Hamilton Parkway it was a pleasant enough journey. Computer dating doesn't really let you know a person. We passed the time enjoyably exploring each other. When we came aboveground and the noise level dropped I took my box off my shoulder. "Would you like a little music?" I asked, turning it on. As the first sounds came through I pursed my lips, then nodded. "It's Mahler's First Symphony, of course. I've always thought it was a little overblown, but some of the themes are lovely—or perhaps you don't care for the late romantics?" She had put "classical music" on her database for the service, and it taken only a few minutes with the program guides to memorize the listings for that evening. But Marian had been into the guides, too.

"That's Mehta conducting, isn't it?" she said deprecatingly. "He never understood Mahler, did he? But you can't deny the Philharmonic has a first rate wind section." She closed her eyes for a moment, satisfied with the way she had performed so far, and I studied her carefully. Her figure was good —eight, at least—and she had thrown her shoulders back cleverly to make the most of it. I thought her eyes a bit too close together, but had to admit she had made an effort to widen them with eye shadow. Annoyingly, I couldn't identify her perfume. It was certainly not one of the standard reliables that always call for a five or a six; she'd taken a chance with something off-beat—rather tropical and jungly; if it didn't become tiresome over the evening I would have to give it perhaps a nine. "On the other hand, Wilbert," she said without opening her eyes, "the Cardinals are in town. The game ought to be starting about the time this symphony's

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over—shall we switch stations then?'' That was a nice try, since I had listed ''sports'' for the dating service—but actually I was more into football and ice hockey. I let it slide, though, and when we got to the end of the line and the conductor came through with the *Won't You Tell Us How You Enjoyed Your Ride?* folders, I was charmed to see that she handed hers over to me to fill out along with my own. The computer service doesn't list ''docility'' in its after-date checklist, but I consider it an important constituent of the ''good personality?'' entry, so she had earned at least four points there already.

The peacekeeping forces at the Coney Island station don't worry much about young couples on a Saturday night. They waved us through with hardly a glance at our papers. There was a cab right there, and in a moment we were at our hotel.

The Tom-a-Hawk is an old hotel, but it was completely refurbished by the Apache Nation's hotel chain when they took it over. It advertises the fastest check-ins in the business. If you and your date are not on your way to your room within seven minutes after reaching the registration counter you get a pretty little feathered hatchet, which is supposed to be exchangeable for two complimentary Bloated Marys in the rooftop bar. Our time was just over five minutes. No hatchet. But we were in plenty of time for the Happy Hour.

The room was a six for size of bed, a nine for the view over the Atlantic, but only about a four for elegance. The furniture had not all been replaced by the Apache Nation. Marian disappeared into the bathroom to freshen her makeup, and while she was gone I rumpled the bed so the night maid would think we had been in it. When Marian came out she glanced approvingly at the bed, smiled and took my arm, turning me so that we faced the wall mirror. ''I think we'll do, Wilbert,'' she said, studying our reflection. I was less sure. Marian was quite tall and blonde. Very good-looking, really, but she was so fair that she made my light brown hair and medium complexion seem rather sallow. I was surprised that she had said that and, as we made our way up to the Sachem's Nest on the top floor, I was thinking Marian would not, after all, score very high for empathy. But then, while we were waiting for the hostess to seat us, she snuggled right up to me, slouching a little so that she could look up into my face. It was an endearing touch. A lot of dates are far more interested in their own appearance than in making their escort look good. For that, a ten.

Then, as we were going to our table, a soldier in the uniform of the peacekeeping force lurched while stepping from the moving outer rim to the stationery inner core and bumped right into Marian. Although I did not yet know his name, it was Arne Kastle. '''Scuse me, lady,'' he said, with an admiring look. ''I guess I'm not used to this high-tech stuff, eh?'' And ten minutes later, when I happened to glance behind me, there he was, staring at her.

A ''Bloated Mary'' turns out to be a kind of vanilla milkshake with grain alcohol added. It is passed under a broiler to give it a sort of baked-Alaska top, then served in a scooped out corn-

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cob. (They call it a "maize" cob.) It is a pretty small drink for the money—perhaps because their punctuality isn't all that reliable, so they keep the freebies small. The purchased ones are no bigger. One round of Bloated Marys went fast, and it was while I was looking for the waitress to order another that I saw the soldier again.

I had chosen three good topics of conversation—childhood memories; sports; and dream vacations—but one of the things I always score high on is going with the flow. I changed the subject without a hitch. "They're SasPeace," I told her. "I watched them parade at the changing of the guard yesterday on television. They were very colorful, although the Ghurkas marched better. The Saskatchewan detachment will be here for six months, then they'll be relieved by one of the other occupying powers—"

"Wilbert," she said gently, "I know all that." A head-on confrontation! A very risky maneuver, so early in a date, but she carried it off marvelously. "I think they look funny in those soldier suits," she laughed. "Don't you suppose they envy you *terribly*?"

Actually they did look funny, because the Ghurkas they relieved averaged about five feet four and the new troops hadn't yet been given a new issue of uniforms. I decided to overlook it. Besides, we were coming around to some interesting views as the bar turned. "Look," I said. "That lighted bridge—it's the Verrazzano. Isn't it pretty? And just beyond it you can see in the distance the skyline of Manhattan."

"And on this side," she said, "is that sandy-haired Canadian soldier. He's coming over here, Wilbert."

Indeed he was. His eyes were on Marian, but he spoke to me. "Sir," he said, "do you mind if I ask the lady for a dance?"

That could have been a really tricky situation. A lot of dates would have handled it badly. Marian was very good. She simply looked at me to see how I felt, read my expression correctly and gave a slight nod. "What's your name?" I asked the soldier.

"Arne Kastle, sir."

"Marian, may I present Arne? Arne, Marian. Have a nice dance." I watched them step back onto the dance floor with a certain feeling of pride; I'd at least matched Marian's cool handling of the incident!

By the time she came back they were getting ready to give out the door prizes and discount coupons. I forgot all about Arne Kastle in the excitement. When it was over and Marian and I had won a two-for-one shore dinner in the Tom-a-Hawk Inn's Lobster Lounge on the Boardwalk, I happened to glance toward his table. All four of the Canadian soldiers were gone.

I wasn't surprised. The peacekeeping forces have no authority in extraterritorial enclaves like the Tom-a-Hawk hotels or their rival Saudi chain. They only come in off-duty hours, to eye the tourists. I commented to Marian, "I guess they've gone back to their barracks."

She looked up from where she was counting our prizes, discount certificates for the souvenir shops and beauty salon and rolls of complimentary coins for the dollar slot machines in the casino. "Who?" she asked.

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"The SasPeace soldiers. They're gone. How was he, by the way?"

She leaned back, tapping one of the discount certificates against her teeth. "Oh—overall, maybe a seven. Not much makeout. He held me nicely while we danced, not too tight, not too loose, and he chatted me up pretty well. But he didn't ask for my phone number." I only smiled, although I was surprised—a seven? Sounded like a marginal five or six to me. "Anyway," she said, "the two-for-one shore dinner is only good if we get there in the next thirty minutes, and the dollars have to be played tonight—shouldn't we get going?"

By then I knew I had lucked in. As I rose and helped her with her chair I was confident that this weekend was going to be special.

Indeed it was. I found my companion inventive and responsive and physically very enjoyable. She was quite beautiful, with her suntanned skin and fair complexion, almost like one of those bikinied Scandinavian tourists who throng our beaches. By the time we were on the return train Sunday night I knew I would have to put this weekend well up in the top ten for the whole year. When she shyly handed me her *How Did I Rate With You?* card as our train dipped into the tunnel for Manhattan I had no hesitation in awarding her four tens, and nothing below a six in any category. I almost thought of making a private date with her for some other weekend. However, that would have verged on a commitment and I knew neither of us wanted that. So I said good night to her at the 23d Street station, just where we had met, regretting—but accepting—the fact that we would probably never see each other again.

Of course, I never thought I'd see Arne Kastle again, either, and I was surely wrong about that.

He turned up in my apartment when it was full of police, and at first I didn't notice him—what was one more uniform among many? Then I perceived that his was Peacekeeper green instead of police blue, and then I placed the face. "Oh," I said, "you're the soldier. How did you find me?"

"I checked your registration at the hotel," he said, glancing around. The police were spreading fingerprint powder and making notes and calling back to the precinct on their hand radios. "It looks like I came at a bad time."

"I've been burgled," I explained, smiling. "They got through four door locks and an electric alarm system, slick as a whistle. You really have to hand it to them."

He looked at me doubtfully. "I could come back another time," he offered.

"Ah, no," I said. "They don't need me here any more—I've told them everything I know. And the burglars got my TV, my stereo, my telephone machine, my exercise bike—I guess they've taken everything worth stealing already, so there's nothing left to worry about. Let's go down to the corner for a beer."

When we were seated at the bar he came out with it. "That girl you were with, eh? Marian? Is she your wife or anything?"

"Of course not, Arne. Just a date."

For some reason he didn't seem to like the sound of that, but he said stubbornly, "I'd like to see her again."

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"Why not?"

"Because I don't know how to find her, that's why not."

"I see," I said, studying him over the rim of my glass. For some reason I felt drawn to the fellow. He was naive and obviously uncomfortable in the situation, but determined. He was not a handsome man—too short and squat, and his eyes squinted a little. Still, there are lots of men with features no better than his who rate a seven or even an eight on personality. Not, in his case, on grooming. He had received a new issue of uniform since the weekend at Coney Island, so at least his wrists didn't stick out of the sleeves. He didn't wear the uniform well, though, and he'd tied his tie in a hard knot stuck up under one corner of his collar. "All you have to do, Arne," I said obligingly, "is call up the computer dating service and ask for her."

"I don't know her last name, Wilbert."

"Well, neither do I! That's not a problem. Just say you want a tall blonde, interested in classical music, baseball, about five seven and a hundred and fifteen pounds—there won't be more than a dozen or so, and you can pick her out from the picture."

His expression said he wasn't liking that part, either, but he stuck to his purpose. "Then they'll give me her address, eh?"

"Certainly not! If you wanted her address you should have got it while you were dancing! Don't you know anything about dating? All you had to do was ask her if she'd ever been to the top of the World Trade Center, or if she'd like to visit the Zoo. . . . She didn't dislike you, you know."

"What?"

"She as much as said so," I told him, thinking it would gratify him. But he only sighed and held up two fingers to the bartender.

"I don't understand you Yanks," he said moodily.

I laughed. "We're just like anybody else," I said.

"The hell you are, Wilbert."

I shrugged. "Oh, we're richer, I suppose. And we're in a sort of a special position since the World's War. But when you come right down to it, what do we want out of life? To have a few laughs, catch a few drinks, make it with some nice chicks—I guess it's just about the same in Saskatchewan, right?"

"You didn't say anything about work," he pointed out.

"Well, of course we work," I said, surprised. "Or we do when there's a job, anyway. Right now I'm in one of those post-war retraining programs, learning how to manage municipal bond portfolios for large corporate investors. It's real interesting, and there's a good chance of employment when I finish the course. For income, of course, I'm on Supplemental. Not full Welfare—I've never been on full Welfare—just the federal subsidy to add to what I get from the retraining program."

He nodded absently. "I wonder if she really would like to see the Zoo? We don't have any good ones in my part of Saskatchewan."

"Ask her, boy," I grinned. He didn't respond. "Go on," I encouraged. "Stick a quarter in the slot over there in the booth and dial the dating service."

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"I've never done that," he confessed.

"There's nothing to it. Just give your name and your credit card number, and tell them what you want. I'd do it for you myself," I apologized, "but they got my computer deck along with everything else."

He looked at me thoughtfully, then reached into his pocket and spilled his change on the table. It was all Occupation money, but that worked as well as anything else. He picked out a quarter and stood up. Just before heading for the computer booth he paused and shook his head. "I guess I still don't understand you Yanks," he repeated.

That was the second time I saw Arne Kastle. Once again I thought it was going to be the last, and was wrong. I graduated from the fund-management program. There weren't any jobs there, though, so I signed up right away for another one, this time in hotel and motel management. Even the Apache Nation hired a lot of locals for mid-level jobs . . . and it was certainly a field I knew well from the other side of the desk!

Because it was a presidential election year, there were a lot of public meetings going on. They interested me a lot. I've always considered myself well informed politically, and so I watched most of the meetings and debates on TV and went to some in person when I could. When the President came to New York for an open-air rally right in front of Macy's, I was there.

So was Arne Kastle. I might have guessed that, because there were at least four or five hundred Peacekeepers deployed there on crowd-control, Iceland and Argentine detachments as well as the Canadians. But I wasn't thinking about Arne. I was concentrating on sideslipping and squeezing through breaks in the crowd to get right up to the police barrier, and when I finally did it was a surprise when the SasPeace soldier right in front of me said, "How you doing, Wilbert?"

I said warmly, "Nice to see you, Arne. Say. Did you ever connect with that girl, what's her name—"

"Her name is Marian," he said shortly, and turned away to chase a ten-year-old back behind the linees. It took him a couple of minutes to get back to me. By then the President's party was getting out of their limos, and I discovered the subject had been changed. Kastle jerked a thumb at the President. "Isn't that the bloke that lost the war for you?" he asked.

"Same one," I agreed.

"And he thinks he can get re-elected?"

I laughed at him. "Hell, Arne," I said, "nobody blames him for that any more."

"They don't?"

"Of course not! I guess you don't understand the American political process, Arne. See, he *acted*. He moved right away to limit damage to his administration. He fired his Secretary of State and shook up the C.I.A. He acted fast and hard—what more could you ask?"

"You could've asked that he not get in a losing war," he said. I started to explain to him that that was ancient history, but a SasPeace lieutenant was scowling at us, "No talking politics with the locals, Private Kastle!" he barked.

As soon as the lieutenant was out of

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earshot I whispered, "Listen, let's talk about this. Give me a call. Maybe we'll take in the Zoo, if you're so crazy to see it!"

Evidently he was, because he did. About a week later we met at Prospect Park, and Kastle was like a kid. "Tigers and elephants!" he grinned. "Lead me to them!"

I grinned back. "Elephants *sí*, tigers *no*," I said, steering him around the seal tank.

"Why no tigers?"

"Well," I explained, "during the last blackout somebody remembered that tiger-skin rugs were worth a lot of money. Here's the elephants, though."

Kastle was the only Peacekeeper in sight—at least the only one in uniform. I could see him realizing that as we walked around, and I could see him worrying about it. When we took time out for a beer in the open-air cafe he fretted, "Maybe I should've come in civilian clothes—I don't want to antagonize you Yanks unnecessarily."

It was a beautiful warm day. Little kids escaped from their mothers to gape at Kastle's green uniform and his holstered machine-pistol, and some of the mothers were looking admiringly, too. I laughed. "They sure don't look antagonized," I said.

"Yeah, well, why not?" he demanded. "Why don't you resent us, for God's sake?"

"Why should we?" I asked reasonably.

"Well, if Canada had lost a war—especially that kind of a war—"

I shook my head. "We're not that kind of people, I guess." Then there was a silence, while Kastle moodily tossed his complimentary little package of peanuts to the kids and we both hunted for a subject for conversation.

We each came up with one at the same time. "How are you getting along with Marian?" I asked, and at the same moment he asked:

"Did you get your job in municipal funds management?"

There was something about his expression that told me he didn't want to answer my question, so I answered his. "That's over," I said. "Hotel management's what I'm into now. That's a growth field, with all the new tourism."

"I thought that was all foreign?"

"Foreign-owned. They sent representatives from the Saudis and the Puerto Ricans to my class to assure us they wouldn't discriminate in hiring. The Japanese are even better about that, of course, but they're all on the West Coast so far and I don't think I want to relocate. . . . Arne? Are you going to ask me if I resent something again?"

He growled, "As a matter of fact, I was!"

"Like the Apache Nation and the Puerto Ricans and so on taking their independence, you mean? But who can blame them for that? I do feel a little irritated at the Alaskans," I admitted, smiling, "after all the federal money they got! Still, the World's War had made us vulnerable, so they had their chance. You can understand why they took it."

"You," he said heavily, "can understand damn near anything, can't you?"

"Now, Arne! What does that mean?"

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"It means you're going to vote for the President who lost it for you."

I shook my head. "We've been over this," I pointed out. "It was basically the Secretary of State's fault." Secretary Messina had been doing his shuttle-diplomacy between Lesotho and Namibia and paying no attention at all to the Caribbean. When Grand Cayman suddenly declared war on the United States and the Soviet Union simultaneously, he was caught flat-footed.

"But the President could've just blown Grand Cayman out of the water."

"Sure he could. He *did* dispatch the Fourth Fleet."

"But they didn't do anything."

"How could they? Grand Cayman was at war with both us and the Russians. If we attacked them, the Russians would've had the right to too—and how would that have looked? Considering the Monroe Doctrine and all? No. The President handled it just right. He made that television speech warning the Russians to keep their hands off the Western Hemisphere. They did, too. And his ratings in the overnight polls went up fifteen per cent!"

He looked at me peculiarly. "And that you consider a success?"

"You bet, Arne! Well, Almost a success, I guess. It would have worked perfectly, if it hadn't been for—"

"You mean San Marino," he said.

I nodded gloomily. "I mean San Marino. And then all the others. But who could have guessed that would happen?" For the second country to make a simultaneous and unexpected declaration of war against both the U.S.A. and the U.S.S.R. was the little country completely surrounded by Italy. They had no Monroe Doctrine to protect them, but what could either we or the Russians do? Neither one of us wanted to drop a missile that would splash fallout all over the Italians. The Italians wouldn't grant us transit privileges so land forces might attack—and, since San Marino wasn't an island, we couldn't even steam a fleet around them.

So there we were, the two most powerful nations the world had ever seen, stalemated in a war with the two feeblest. And then abruptly Lesotho made a surprise declaration of war on both of us, delighting Secretary Messina immensely—until Namibia did, too, half an hour later; and then Liechtenstein and Bangladesh, and Oman and Andorra. In seventy-two hours we were at war with every country in the world with a population under twenty million . . . and then the heavyweights began to come in. Mexico, Yugoslavia, Canada, East Germany, Brazil and Romania declared against both superpowers in a six-way conference-call satellite message that was seen by the whole world. Then France, then China, then Poland, then England. . . .

By the end of the week the whole world was technically at war. On one side, 141 nations. On the other, the Russians and us—and never a shot fired by anyone. After it was all over we got to see that famous tape of Secretary Messina in the Oval Office, sobbing and pleading with the President to declare war against the Soviets so we could fire the missiles at *somebody*. But how could we? They were the only ones on our side.

And they didn't like it any better than we did.

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I leaned across the table to Arne Kastle, "Man to man," I coaxed, "was that whole thing set up in advance?"

Kastle slammed down his beer cup. "How the hell would I know? The Premier doesn't consult prairie-province plow jockeys about his foreign policy." He stood up agitatedly, reaching in his pocket for Peacekeeper coins to toss to the circle of kids. "Wilbert," he said. "do you think life is just a spectator sport? Don't you ever get tired of being a critic?"

"We're a very sophisticated audience," I agreed.

He glared at me. Then he shook his head and started to leave, but I put out a hand to detain him. For a minute I thought he was going to hit me, but all I wanted was to point to the cards on the table. They were cutouts in the shape of camels, and their covers said, *Won't You Bark/Roar/Growl/Chirp a Few Words of Advice for Us?* "You forgot to fill out your comment sheet," I reminded him. But he didn't do it. He just sort of stared into my eyes, and then moaned and blundered away without another word. I had to fill them out for both of us.

The last time I saw Arne Kastle he just showed up at the door again. He appeared, still in uniform, with a six-pack of some Canadian beer, and the first thing he said was, "I guess I was a little out of line last time, eh?"

I considered the question. Actually I would have given him no more than a four for congeniality and maybe less than that for tact, but I didn't think he wanted to hear that. I just opened the door wide and said, "Come on in. The place is in a little better shape than the last time you saw it, isn't it?"

He glanced around. "Very nice," he said politely—no more than a six for the words, but his tone was almost a nine. "I see you've replaced all the stolen stuff."

"That's what insurance is for, Arne," I grinned, putting out glasses and pulling the tabs on two of the beers. "Of course they ripped me off some," I continued. "My alarm system was two years old, so they deducted twenty per cent on the grounds of defective equipment. Then they depreciated everything for age and wear. I guess that was nearly thirty per cent more. They really outfoxed me but what the hell, you have to hand it to them."

He exploded. "Why? Why do you have to hand it to them? Always the critic—you're as bad as Marian!"

The light dawned. "Ah," I said sympathetically. "You've seen Marian, then." He nodded sullenly. "Well then, listen, Arne, did you keep a copy of your card on her? I'd be interested to see how close we came in rating her."

"I didn't rate her at all!" He took a long pull at his beer, looking sulky and distraught. "I proposed to her," he said abruptly.

"Proposed!"

"What's wrong with that?" he demanded. The expression was belligerent now, so I just shrugged. "Well, I did, and she didn't say yes and she didn't say no. All she said was that I'd hear from her in a couple of days, and when I did it wasn't an answer. It was a checklist!" He dragged a blue-jacketed folder out of his pocket and hurled it at me.

I opened it, keeping a cautious eye.

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on him—he seemed in a very unstable mood. But then I got interested. You can learn a lot about another person by the way they rate someone else, and I could see that Marian had taken a lot of trouble over this one. I was amused to see that she'd downrated him on "grooming" because his civilian suit wasn't as well pressed as his uniform —this from Miss Lipstick Smear! Then I came across something that made me indignant. "Oh, hell, Arne, this isn't fair! 'Proper speech, four.' But that's unreasonable—you're Canadian, after all; she can't expect you to speak English as well as an American!"

He began furiously, "A Canadian can *damn* sure speak English as well as a Yank!" But then he slumped back. "What's the use? Look at the overall rating. Six point two. She says she won't marry me unless I can get up to at least a seven—and then she wants a no-contest divorce if I ever drop down below seven again."

He stood up. "Well, thanks for listening," he said, starting toward the door. "Our tour of duty's almost over, so I guess I won't be seeing you again."

"Back to Saskatchewan, then?" I asked.

"And not a minute too soon," he said bitterly. "But it's been nice knowing you, Wilbert."

I said, "Same here, Arne. I'd give you an eight for originality in conversation and—" I hesitated, then decided to stretch a point in his favor— "maybe even a nine for good company!" But I couldn't give him anything for good manners, because he didn't even thank me.

* * *

I never saw Arne Kastle again, and neither did Marian. The funny thing was that we did see each other. The computer dating service threw her picture up a couple weeks later, and on impulse I signed in. I was surprised when she agreed to another date. I guess it was the same reason in both cases. The little man had intrigued our curiosity, and we wanted to talk about him.

I won the toss again and took her to the Starlight room of the Waldorf Asto-Rican—a little pricey for my pocket usually, but a hotel & motel management course had provided me with some two-for-one coupons. "I might almost have married him," said Marian thoughtfully, neatly folding the paper parasol from her Puerto Pep and placing it beside her plate, "if it weren't for his, well, craziness."

"I know what you mean," I agreed. "He had a lot going for him. Personality—oddball, sure, but kind of endearing, in a way. Sense of humor—"

"Oh, a ten anyway, Wilbert!" she giggled. "You should have heard some of the things he used to say about you!"

I had been thinking of at most a seven, but I was shooting for a ten in amiability so I just let it go. "But then there were his goofy ideas," I said.

"Right. I think the worst part was his complete misconception of what society is all about. Naturally we have high standards here. We expect our politicians to play the game well. Sure, sometimes they shade the law a little, or take a little graft—"

"That's just hardball politics," I nodded.

"Exactly, and that's where he fell

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down. No sophistication. No grasp of reality."

I was so touched I reached over and took her hand. "I wouldn't have given him more than a two for either." I said, and for a moment there I almost blew the whole thing by suggesting we go steady. Sweet Marian! I don't think I'll ever draw a girl as sensible and easy to get along with as she again. It could almost make you want to *marry* her.

But fortunately I got my natural sense of objectivity back in time. The weekend passed without my spoiling it. The President won easily, by the way. He was lucky enough to find a technical excuse for voiding about half a million votes for the other guy in one of the Eastern states, and naturally when the rest of the nation heard about that they fell all over themselves jumping on the bandwagon. What a performance! It was a perfect example of all that's best and most admirable in our system. What a pity the rest of the world can't learn our ways! ■

● Some of you may remember when the mysterious Kelvin Throop first appeared in the pages of *Analog*, almost twenty years ago, with his pathological penchant for answering letters and memos *honestly* and thereby getting well-earned barbs into a wide range of deserving and all too real targets. Some of you may even remember the night he sneaked into the Editor's office and answered some letters from *Analog* readers, and Ben Bova published some of his replies on the editor's page.

Mid-December is a very special occasion, marked by a very special issue of *Analog:* the Kelvin Throop Special Issue. Fulfilling an ambition he has harbored ever since that notorious night, the notorious Throop has somehow wangled for himself the chance to be Editor for a Month. What kind of an issue has he put together? Well, it includes Part II (yes, I *know* we didn't have a Part I!) of the exciting serial *The Didactics of Mystique,* by Flash Richardson (a.k.a. Grant Callin, with apologies to Gordon R. Dickson). He has apparently gotten a whole bunch of writers just a wee bit tipsy and cajoled special stories from them (including such as Joseph H. Delaney, Laurence M. Janifer, Rick Gauger, Richard K. Lyon, Arlan Keith Andrews, Sr., and Hayford Peirce). He has similarly corrupted a whole bunch of otherwise perfectly respectable artists into suitably illustrating these stories (Jack Gaughan's cover is for Charles Sheffield's "The Hostages of Zark"), and he has somehow even browbeaten our esteemed publisher into giving him some extra pages to make room for as much of this stuff as possible. We'll also have a Very Scholarly fact article "On the Einstein-Murphy Interaction," direct from a Very Scholarly scientific journal, for those of you who've always wondered *why* the bread always falls butter-side down. Throop got his fingers into every part of this issue—he even made Jay Kay Klein write his Biolog—and I grudgingly admit I think you'll enjoy the results.

IN TIMES TO COME

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On Gaming

Dana Lombardy

Larry Niven's *Ringworld* series has been made into a role-playing game. It required one background author, eight designers, seven artists, plus a host of playtesters and production people for Chaosium Inc. to translate the famous *Ringworld* books into a game. The result is an incredibly detailed and beautiful work ($25.00 at your local store, or direct from Box 6302, Albany, CA 94706).

First off, it's not a game about space warfare. As an imaginary adventurer 900 years in the future, your gaming involves exploration, alien contact, intrigue, and discovery. While there has been armed conflict in the past, violence is used only as a last resort. The game rewards problem-solvers—not those that use brute force.

Niven created the Ringworld in the 1960's. His novels present this world as a logical step in the theory that we humans are going to need more area than Earth can provide to live on. The Ring is constructed of extremely strong solid matter, called "scrith." Encircling a star, the Ring is hundreds of meters thick, 997,000 miles wide, and 597 million miles long. It has three million times the surface area of Earth. Imagine Ringworld as millions of terrestrial worlds all mapped flat and joined edge to edge.

To provide the necessary atmosphere and gravity inside the Ring, and to keep the ring rotating rapidly around the sun without flying apart, and to withstand radiation and meteor hits requires great strength and enormous amounts of energy.

How it all works, what scrith's composition is, and who built the Ring are shrouded in mystery.

The ring is not of human-making, nor do the people of Earth (called "Flatlanders") live on Ringworld. Many alien races and species live there, and on Earth many species have evolved to high levels of intelligence, including Dolphins. The sentient beings of Earth have, by the 29th Century, colonized hundreds of worlds and made contact with the Ringworld.

This is where you step in—as an "explorer." *Ringworld* is unique among role-playing games in that in terms of age, your character can be anywhere from late teens to more than 400 years old. This is possible through a rare and fantastically expensive antiagathic drug known as "boosterspice."

Each character has eight dice-acquired attributes: strength, mass (size and weight), constitution (endurance), intelligence, power (as in will-power, luck, and psionics), dexterity, appearance (which is partly a character's charisma), and education.

Not only can you role-play a human character, such as a scientist, an engineer, a soldier, etc., but you can also be an alien character. The most interesting examples of aliens you can become include the puppeteers (highly-intelligent, two-headed, tripedal herbivores who are more advanced than humans technologically, but who shun aggression and are staunch pacifists), and kzinti (creatures evolved from carnivorous bipeds resembling giant cats,

(continued on page 176)

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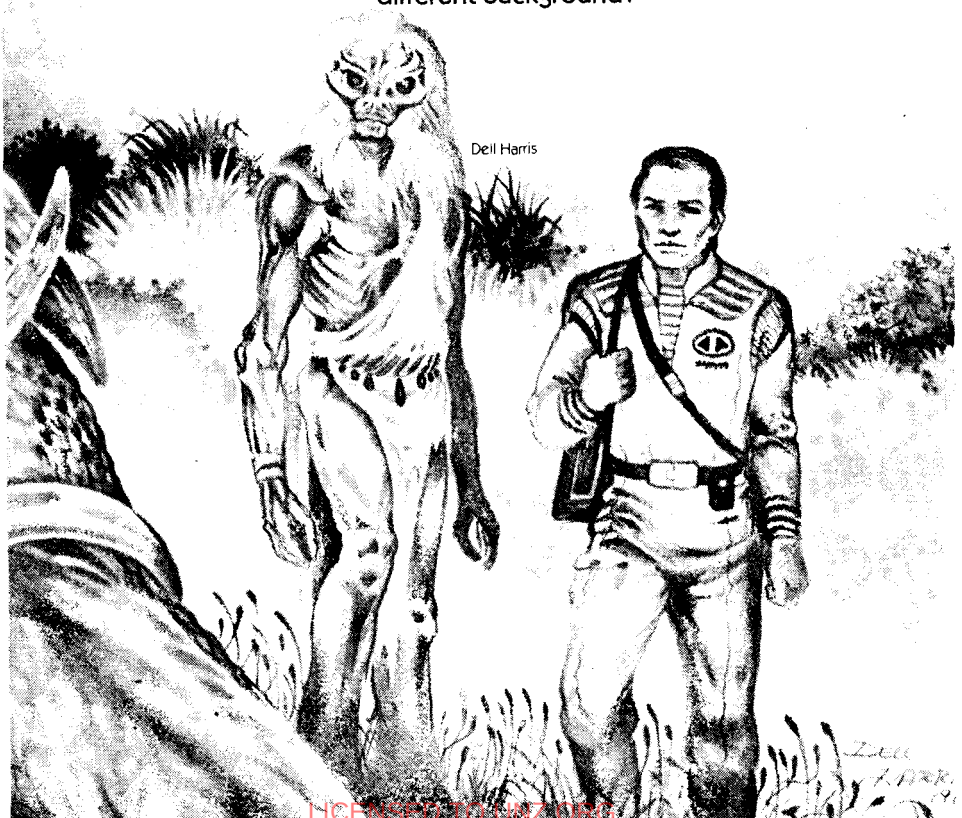
Q.E.D.

Bruce Stanley Burdick

Any intelligent species
is likely to have its own
concept of "personhood,"
based on its own
character and experience.
But how can they apply
that concept to another species
with a completely
different background?



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Found in the library of Aarien University, in reappearing ink, the account of what happened to Simon Janov, in his own words, wherein he saved either an alien race or a human colony from destruction; he was never sure which.

The Plexians of Wiley's World tell a joke of sorts. During the dry season a person, a keti bird, and a human observe that the hruri plants wither. The person does nothing. The keti bird does nothing. The human irrigates.

Just a few years ago I wouldn't have laughed. In those days I was the alienologist with the first wave of the "Holy" Colonization. Often enough, an alienologist on a new planet ended up being little more than an assistant xenobiologist, but my fate was to be more interesting. We discovered the Plexians a few days after our arrival. Shortly they were talking to us. In English.

I had been trying to figure them out ever since. They seemed to have a natural ability to acquire new languages; they would identify new words by context, and use them right back at the speaker. However, with my efforts to learn Plexian, they were unhelpful, except to the extent of telling me, in English, that I was doing it wrong. So I learned slowly, trial-and-error style.

The Plexians had civilization without construction. Their technology was applied ecology. They controlled the plants to grow in such ways as to provide just enough shelter and food; they controlled the animals to live in such places and eat such things as suited the Plexian scheme. And when we humans arrived, they learned how to control us, before we were aware of it.

* * *

The day the fourth wave ran into trouble I was sitting on a low hill, half admiring the landscape and half immersed in matters more abstract. Around me was a Plexian village, which my mind insisted on breaking up into houses and gardens, parks and amphitheaters, although the distinctions were not that sharp. The enclosures were just places where the branches of several trees had intertwined, their leaves slanting at a uniform pitch, to divert the rains and breezes. The open terraced areas did not serve as Plexian meeting places; it was just as likely to see there a single Plexian sitting quietly, or a flock of keti swapping tall tales.

The scene was pleasing to my eye, disturbing to my mind. I was used to cities laid out in geometrical patterns, whose buildings were variations on a small set of shapes: pyramids, cones, parallelepipeds. The village before me seemed haphazard, yet harmonious. It had the feeling of being unplanned but not quite natural.

There may have been natives about that day, sitting by the river, or managing the dhoori herds, or telling the trees which way to grow, but I don't recall noticing them. I was occupied with trying to understand the thought processes of alien minds. Each of us in the colony had his specialty. The xenobiologists, of course, were busy with the farms, the engineers were fussing over the devices of our physical culture. Even the theologians were at work, analyzing the faces that the sky gods presented to us in our new home. And I was in charge of aliens.

The Plexian logicians, like ours, had

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long ago invented a formal system which modeled the thought process. When I learned of this I tried to have the system explained to me, but I ran up against a problem. In order to understand a symbolic logic, one must have a feel for the intuitive reasoning upon which it is based. Without that background, the symbolic language reduces to gibberish. My Plexian tutors were rather oblique. When they realized that what they regarded as clear was very muddy to me, they just gave up.

I did not find the key to the Plexian viewpoint that day, but I continued working on the problem while on my way to report to First Colonist Wiley later that morning. During the hovercraft trip up the river to our base, I had an idea. Human propositional logic was a two-valued calculus, having truth versus falsity as its fundamental duality. The Plexians had made no mention of this concept, and that might have been why their system was so alien to me. Perhaps some other duality was basic to the way that Plexians thought about thought. I made a note to check this on my next trip.

After docking, I took a shortcut through the experimental farms which lay between the river and the prefab structure where Wiley kept an office. On my way I passed a field where one of the tall dark natives stood with two human farmers. It wasn't unusual in those days to see one or two Plexians hanging around the colony. They were always eager to talk and they never caused any trouble.

A cloudless sky made for nearly unbearable heat, as the sun approached its midday height. It was a relief to get indoors, but my respite from anxiety was to be short-lived; since confronting our spiritual leader always made me a little nervous. I took several lungfuls of conditioned air before I announced myself.

"Come in, Janov," I heard Wiley say past the half-open door to his office. I stepped through and saw our First Colonist reading, one foot sharing desk space with stacks of papers. He straightened up quickly, without looking at me; his dark black hair, thick eyebrows, and handlebar mustache lent his gaze an intensity I could already feel, though his attention was still directed at the printout he was holding.

"Sit down, Janov." I picked out a bench of native wood and began looking around the office. The walls were decorated with pictures of the night sky as seen on several different planets, plaques with slogans like "to live is to grow . . . to grow is to expand" and "Never say stop!" and other popular sayings, a family portrait showing a young Wiley wearing the cap and tunic of a priest and standing next to proud parents, a harpoon of a type used on Aaron's World, and a sword and scabbard from who knows where. Wiley sat there behind his stone-topped desk, twirling the end of his mustache around his finger. He began to read out loud. "' . . . in short, you have today reached the culmination of a prolonged and wearisome migration to alight upon this planet, our home. We are a thriving colony, but we need your help. We welcome you, the new members of our society. We have a place reserved for each of you.' Some speech, eh Janov?"

"It sounds quite eloquent, sir."

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"Yes, sometimes the computer writes a fine speech. Hmm. I think I'll change 'migration' to 'pilgrimage.' "

"I take it the fourth wave will be getting here fairly soon."

"Yes. That reminds me." He touched the intercom on his desk, and the sound of chimes could be heard over the line.

"Communications. Stewart here."

"When do we hear from the fourth wave next?" asked Wiley.

"There's a message due second shift, 932. That's 15:49 local."

"Send me a copy. I'll be in my office."

"Yes, sir."

Wiley switched off and turned to me. "So, how are your language studies going?"

"Very slowly," I said. "The problem seems to be a different way of looking at the world. The difference affects even the most basic concepts."

"Well, it doesn't matter too much, since they can speak English. The important thing is, do you understand them? How do they feel about us?"

"They seem to tolerate us."

"Can you predict their reactions to whatever we might do?"

I thought about it. "What do you have in mind?"

Wiley leaned forward, elbows on the desk and fingertips pressed together. "Let me remind you that in just a few years this colony will increase tenfold. We will be expanding, clearing more land, sending out splinters, and starting on a real city. We need to know if these Plexians, as you have named them, will be an obstruction."

"I'll look into it," I said. "I'm sure they'll be able to find room for us. The upriver region is sparsely populated."

"We won't have time to be accommodating. We will go where it suits us, and that will be downriver. We expect to find choice farmland there."

I felt a little uneasy about his attitude. "Of course, it has occurred to you that the Plexians were here first."

"That is why every first wave has an alienologist, because the aliens are always there first. We want to avoid incidents, and we don't like surprises. It's time you lost your innocence, Simon Janov. Your duty to the colony is not just to talk to aliens. You will tell us, will the xenos move out of our way, or will we have to use force? And may Destiny spare you if you're wrong."

Imagine: why would a planetful of humans want to send out colony ships across interstellar spaces? The speed-of-light limit guaranteed that the mother world would see no economic return within an investor's lifetime. And for the same reason, the colony world would be politically independent; there was no hope of building an interstellar empire when communication was so slow. So why would a world government divert its resources toward such a venture? The answer in our times was religion.

Religion it was that directed man's eyes upward to behold his destiny. Religion taught us that a culture could only thrive by sacrificing a part of its wealth to the stars. This religion endowed us with a grand heritage, united us behind a common purpose, and perpetuated itself from one system to the next.

I didn't care much for this religion.

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Of course, that's typical for an alienologist; he knows too much. What should a person know, to be ready to deal with aliens? All of human history, economics, anthropology, linguistics, sociology, xenobiology, cybernetics, philosophy, biomechanics, psychology, game theory, politics and diplomacy, symbolic languages, comparative religion, hand-to-hand combat . . . who could know what fact might prove most useful? So, all the recorded knowledge of a planet was always made available to those few who were picked to be alienologists, even the most strictly censored materials.

Given free rein to browse through the restricted tapes, I read widely, wherever my curiosity led me, and especially in philosophy and the history of ideas. I became disillusioned with our religion and our political structure. These weren't totally bad; after all, they made it possible for me to be with the first wave of a new colony. Nevertheless, when I read about democracy, I couldn't help but think critically of our system; when I read on the sociology of religion, I couldn't help but notice that our religion maintained the status quo, keeping the same people in power; and when I read in the histories about how one group of people often invaded a new area and annihilated the natives, I saw that we were very likely to follow the same pattern.

I had some idea what was going through Wiley's mind that day. I had once coaxed a reluctant computer into executing a steal-and-display on certain passages from the *High Priest's Handbook*. There I had read, "Always be wary of the alienologist. He is unpredictable and hard to discipline, prone to adopt heretical beliefs. You may threaten him or intimidate him, but do not punish him for his heresies . . . only if he threatens the growth of the colony, do not spare him."

My eyes locked with Wiley's. He waited for my reply. I felt somehow that there was no sense in arguing with him, but I couldn't bring myself to agree with him. I didn't want to be an accomplice to what he had planned. I came up with what I saw as a noncommittal answer. "I'll see what I can do."

"Good," said Wiley. He leaned back in his chair and tried to look casual again. "You know, Janov, I know you have doubts. You follow the pattern of all alienologists, and part of my job, among millions of other things, is to keep an eye on you. You've got to realize that, in spite of the broadness of your education, I know more than you about how to run a planet. That's my specialty.

"Now there's no need for us to be too formal here, when it's just us. When something is bothering you, come straight to me and we'll talk about it." He smiled. "There's no need to keep things inside, and especially there's nothing to be gained by discussing these things with the other colonists, right?"

I didn't want to answer, so it was a relief to hear the intercom chime. "Yes," Wiley spoke to it.

"We just got an emergency message, sir. I'm outside your office."

"Come in, Stewart."

The communications chief stepped into the room and handed Wiley a tape.

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"What's the problem?" asked Wiley, as he inserted the tape into his reader.

"The captain of the *Denver* says that the engines have shut down. They're getting no thrust, no deceleration."

Wiley looked at the reader's screen. "It says here that all the indicators say the engines are still on."

"Yes, sir. The juice is flowing, the fields are up, but no thrust. They say that if they don't get it going this shift then there will be no way they can stop here on a first pass."

"Couldn't they make it up later by stepping up to two gees?"

"Apparently, sir, unless they fix it in about four hundred microans or so, it would take a bit more than two gees, and they're concerned that some of the cargo wouldn't take the stress."

"I see. That sounds like a bit of poor planning to me. We should always plan for what can go wrong, right Stewart?"

"Right, sir."

"All right, we've got some experts on this sort of thing. Janov! Find Schwarz and Tanaga for me. Stewart, you stay here while I read the rest of this tape."

I let myself out of the office and used the radiophone by the entrance to locate the two physicists. Maria Schwarz turned up in the computer shack, working on some problem, while Emile Tanaga was in a shuttle, on his way to where the *Anchorage* lay in orbit. I stayed there, relaying messages from one to the other, until Schwarz had a linkage set up from the computer to the phone in Wiley's office, at which point she came right over. I kept a line open to Tanaga, long after I had told him everything I knew. He was saying, "Let me know as soon as—" when someone in Communications interrupted.

"Are you done with this frequency, Janov?"

"I need to hold it open. This is an emergency situation," I said.

"You'll have to talk to the chief. He's—"

"He's here, speaking with the First Colonist. Shall I disturb them?"

Puzzled silence was the reply. Stewart stepped out of the office and said, "Janov, get Communications and tell them to keep a line open to Tanaga." I just held the mouthpiece out for Stewart until he got the idea. I let him take over his department and I stood by the office door to eavesdrop. Schwarz was going on and on, thinking aloud, in the way of those who do differential equations in their heads. Wiley interrupted.

"Janov!"

"Do you need me for anything else, sir?"

"Uhm, no. Yes, just one thing. Don't mention anything about this to anyone else, right?"

"Right!" I said. I left, going back out into the heat, and then began looking for a cool place to spend the afternoon. I ended up with the computers, pretending to use a terminal for some language analysis, when actually my mind was preoccupied with moral issues. Unless the aliens and I were lucky, I would eventually be called upon to help Wiley execute a plan that I felt was wrong. My question that afternoon was whether I should tell Wiley right away that I refused to cooperate, or wait until the problem arose.

While the screen displayed the various sorts and selective lists I had called,

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I remembered the Parable of the Word for War. It seems that an alienologist once told his superiors that the aliens with which he worked had no word for war. This information was misinterpreted. It so turned out that those aliens had words for slaughter, aggression, massacre, assassination, raid, murder, ambush, bloodbath, siege, duel, hostility, mercenary, skirmish, *coup de grâce*, espionage, carnage, kamikaze. In fact, they had as many words for the aspects of war as we had, except they didn't have a single word for war.

The Plexians didn't have any of these words, I was fairly certain, so I don't know why that old story came back to me that afternoon.

I retired early that evening, and got up before dawn. On my way to the river I spotted Stewart heading in the direction of Wiley's office. I stopped him. "Have they straightened out the problem on the *Denver* yet?"

He looked at me drearily, as if he hadn't caught much sleep. "No," he said, and continued on his way.

At least two shifts had passed since the emergency message had come, so it appeared that the fourth wave was going to be considerably late. Not only were they not killing off their velocity, but it occurred to me that if they were coming around the sun too fast they would swing wide, and miss us by quite a bit. At this point Wiley must have been considering a rescue, using the other three starships we had in orbit.

Thinking there was nothing I could do to help, I walked down to the river, and went on to the Plexian village.

I reached the village and headed for the leaf-house where I last had conferred with the natives. Halfway there I was intercepted by four Plexians, converging on my path from different directions. I stopped walking. The one in front of me said, "You are the Simon Janov? Let's go." Two of the others grabbed me by the upper arms and began moving.

The Plexians, mind you, are tall and have long strong arms, each of which ends in four pairwise opposable dactyls. When these finger-thumbs are spread starlike, the tendons pull radially. Being in the grip of these hands reminded me of the bite of a certain eel native to Aaron's World.

To end the discomfort, I summoned my best Plexian accent and recited, in Plexian speech, their Golden Rule. "You shall not control a person!"

My two ushers let go of me and stepped back, the four of them forming a circle around me. They were confused now, that I could tell. They had been sent to herd me to some place, and the last thing they had expected was for me to claim the rights. The first one stared down at me with cold gray eyes. In English, I asked him, "Where are we going?" He replied, "To the Khor Kohli." I decided that this Kohli of the clan of Khor could probably answer my questions as well as any of them, so I said, "Let's go." They began walking again, flanking me on four sides, and we continued in that formation for most of the day.

Khor Kohli sat under a huge fruit tree. His round gray eyes were the foci of a set of fine wrinkles, flowing over his head like the wavelets from two stones

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dropped into a pool. The Plexian mane of greenish tufts was full and thick on him, extending around his neck and encroaching upon those collar plates which anchor a Plexian's long arms. His skin was very dark, even darker than my own. He sat on his heels upon the hide of some animal; between us lay a few square meters of ground free of grass and debris.

I took him to be very old. His English was excellent. He said to me, "I am Khor Kohli, and I've been expecting you, Simon Janov. What we sort of call the time of understanding has come, and we have taken action. An afterthought brings you and me together to talk about things."

"What action have you taken?" I asked.

"We have controlled the new ship not to stop here."

"I find that hard to believe," I said. Then I thought about it. How could they know about the trouble on the *Denver*? It was common knowledge that the fourth wave was on the way, but how could they know that the ship's engines had failed? I wouldn't know myself if I hadn't been in the right place when it happened. I decided that it might be wise to play along. "Okay, I believe. Why?"

Kohli rested his fingertips on the ground and rocked slowly forward and back. "When you humans got here we didn't know what to make of you. You began running around, changing the shape of the land, and you did us no harm. We were ready to believe that the Home of the People was now home for two kinds of people. We watched you carefully. We waited for understanding, and it came. So we acted."

"Wait a second. What did you suddenly understand?"

"Suddenly we understood you were not really people, you see."

"Oh." My first reaction to this announcement was to hope it wasn't anything I personally had done that caused this decision. "What did we do wrong?" I asked him.

"All the food plants in your colony will soon die. What's more, none of you were aware of this. People would be aware that the plants will die. People would do something about it. So, we decided that you are not people, that it was okay for us to control your ship. We saw that you are not people, and we had to act, so you would not get out of hand. It is not good to let the nonpeople go uncontrolled."

Slightly relieved that the situation was not my fault, I began to wonder if there was any hope for Kohli's people. If I reported this foolish conversation to Wiley, the natives would surely get crushed. Why was Kohli telling me all this? There was nothing to lose in getting all the information I could, so I asked him, "Why are the plants going to die?"

"Your improper acts have killed all the norang kurhi. Bugs, to you. Without these bugs, the plants die. You did not know this. Without these plants, without our help, you will die."

"I'm beginning to see. So you took it upon yourselves to control us. Don't you know that we have food stored up, that we brought food here from Aaron's World? Don't you know that we have machines that can blast your villages

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into the sky? If the leaders of the colony find out about your attitude, you'll be in big trouble!''

''No trouble. We control the land beneath you, we control your ships from getting here. Some day you will all die, without our help. What's more, who's going to tell them?''

Then I got worried. I had to admit that time was on their side, and if they prevented me from returning to the colony, that would give them lots of time. I began to wonder if I could make a break for it and run all night, without letting the natives catch up with me. ''Why did you decide to tell me all this?''

''When understanding came, we realized that you were the only human who could make the group a threat to us. We separated you from the rest, so that everything will be under control.''

I had to chuckle at that, in spite of my fears. They had overestimated my power in the colony by quite a bit. Of course, there was no point in disagreeing with them, if I could somehow use their respect for me to my advantage. I decided to try to change his mind about humans:

''You have decided that we are not people, but I think that you jump to conclusions. After all, we have a magnificent technology; we build ships which carry us from one star to another, we have machines that can raise hills, or level them. We have a very versatile language, in which we can tell stories, express feelings, teach new knowledge, give orders, formulate our thoughts so that we can share them; this language can be either written or spoken. We share a rich social life, admitting all kinds of relationships and loyalties. We have high ideals; we are able to transcend our instincts, our animalistic natures, to do great and noble things.'' I was laying it on thick, hoping to impress him, but I began to run out of virtues. ''So we must be people!''

Kohli was shaking his head in a human way. ''No, Simon Janov. Listen. The keti speak a rich language; they tell stories, ask questions, make up lies and insults, voice their desires. The talnora, in the sea, whistle and whine at each other, and feelings they express are deep. The kendurhi leave messages for each other, to tell where they are going and where they have been. The tananhi make the—what's the word for things that go like this?'' He moved his hand in a circle.

''Turning? Rolling?''

''The tananhi make the turning rolling thing, for traveling across the flats, and the kalana put treebranches together for floating down the river. There are others. None of these are people.''

''But we can do all those things!''

''This is true. So what?'' Kohli raised his long arms upward in a semicircle, then brought them together again, fingertips touching. ''Listen, human, to what the People do. The People are in control. We tell the trees which way to grow, and we tell the herds which plants to eat. We speak with the keti and talnora, we understand how they think, and we guide them. We figure out the scratchings of the kendurhi, and in turn, we leave messages for them. We cause all kinds of life to mix well on our Home, and watch over everything. We even understand the difficult humans. We speak with them, we hear their sto-

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ries and their desires. We understand them, and bring them into the shade of the tree of control. There is no connection between one thing and another anywhere that escapes our attention.

"You, on the other hand, have tried to learn the true language of the People, but you can't. You have tried to understand the true ways of looking at things, but you don't have the ability. You are great among humans, since you tried, but your own case shows that humans just don't have what it takes to be people. There are things we do that you can't do, but there is nothing you do that is beyond us, should we wish it."

At that moment I swore to myself to make him sorry he had said that, but at the time I had no idea how to refute his boast. "Kohli," I said, "if I showed you that humans could better anything you could do, then humans would be people, right?"

Kohli slapped his hands three times upon the ground before him. "You speak like the keti, now!"

"Of course, we are different races, and there will be things we do better and things we do worse. But if we did just as many things better as worse, then would humans be people?"

"How do we decide 'just as many?' They would have to be important things."

"If we found things we could do that have escaped your attention, would that balance the things you can do that escaped our attention?"

"Yes, I guess so, if they were important things."

"If I found just one thing that should not have escaped your attention, but has, then would humans be people?"

Kohli rubbed the top of his head before replying, "Yes."

"If I found one thing that confused you, that was not clear to you, that made you doubt that you had all the answers, one connection you had not noticed, or one question you should be able to answer but could not answer, would that mean that humans were people?"

"Okay."

"Fine! Give me tonight to prepare, and we'll talk about it tomorrow."

Kohli slapped his hands on the ground again. "Fine! This will be interesting."

They gave me a leaf-hut for the night, leaving me a bowl of mysterious stew and a thick leaf for a spoon. Herders watched their beasts within sight of my lodgings, obviously keeping an eye on me as well.

I stayed up most of the night, reviewing in my mind all of the creations of human intellect that I could recall. The problem was to find things I could put into terms which Kohli would feel were important. I already knew that technological accomplishments didn't impress him much. He seemed to believe that if his people wanted to duplicate our technology, they could. So I concentrated on abstractions, namely, philosophy, theoretical science, and mathematics. I tried to remember the puzzles and the paradoxes, the fallacies and the dilemmas, which humans had invented to entertain each other. I had to find just one thing that would stump Kohli, and it didn't matter much what it was. So I tried to arm myself with as many questions as I could remember, hoping one would work.

Most of my ideas had to be rejected. I couldn't use any tricks with numbers,

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since the Plexians, as I already knew, didn't think numbers were important in themselves. And many of the fallacies and paradoxes obviously stemmed from the use of words with double meanings. They would expose themselves as soon as Kohli translated them into his own words.

But gradually my list of tactics grew. There were a number of questions which seemed to offer some chance of catching Kohli, and which I could infuse with importance. In my arsenal were problems associated with names like Descartes and Russell and Einstein and Gödel. Naturally, I overlooked some possibilities that occurred to me much later, but I think I did pretty well for a night's work after an all-day hike.

When I took a break from these considerations, and let my mind wander, it came to me how old these questions were. Where were the present-day abstract thinkers? I could not think of any significant development in pure science or philosophy since the invention of the tachyon drive. Was it possible that in our rush to jump from one star system to the next we had supressed any endeavors that were not intimately related to practical problems? Given the attitudes of the priesthood, their tendency to censor and to indoctrinate, it seemed very possible.

At some point then, I nodded off, and slept until the Plexians came for me in the morning.

They brought me back to the place where I had met Khor Kohli. He was sitting there upon the animal skin under the tree. I sat down across from him. The contest began.

First I hit him with the method of doubt. "We have in our minds ideas, which are named by the words we use. Ideas, in turn, are supposed to refer to things in the world around us. Isn't this true?"

"I suppose so," Kohli replied.

"These ideas that refer to the world must come to us through the senses."

"Like what you make when you make sense?"

"No, the senses. Seeing, hearing, and so on."

"Oh." The Plexian began flexing each finger: "Color, shape, place, voice; odor, pressure, heat, and khu ihi."

I decided to put off worrying about what his eighth sense was. "In fact, all our ideas must come to us from the senses, if indirectly. If we had never had senses, what would there be to think about?"

"Who can say?"

"But the senses can fool us, as you know if you have seen fish in the river; they seem to be closer than they really are, no?"

"Without proper understanding, the senses can fool us."

"If the senses fool us sometimes, and we know it, they could be fooling us all the time and we wouldn't know it. All this could be a dream."

"Dream?"

"Do you have dreams when you sleep?" I asked. "False experiences?"

"You mean memories that no one else agrees with."

"I guess so. Life could be one of those, even to the point of everyone's agreement being a part of the dream. Since this could be true, how can we know if there is any reality out there at

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all? Of what can we be sure? Do you see the problem I'm getting at?"

"I see no problem," said the Plexian.

"How can we be sure whether our ideas are true or false?"

"True or false is not the problem. A person gets ideas from the senses. When the time is right he acts. His act is either proper or improper. Proper or improper is the problem. What is the difference between acting when the senses are good, and acting when the senses are bad but there is no way to tell? What is the difference when there is no way to tell? True or false makes no difference. Proper or improper is not changed."

"Actions can be proper, even if they are based on false impressions?"

"Yes, when there is no way to tell the difference."

"I see." I was impressed. Kohli had made a great leap from the precipice of idealism without falling into the solipsistic chasm; he had found a toehold in a weird sort of pragmatism, so it seemed. So much for the method of doubt.

Next I tried Russell's Paradox. "Our ideas refer to things in the world,but sometimes our ideas refer to bunches of things which share certain properties. There is the idea of persons and the idea of keti birds, the idea of things that are green and the idea of things that are food. Whenever we can put into words what the shared properties are, we have made an idea. I can have in my mind the idea of all kinds of animals; each kind of animal is itself an idea. If I can put into words what certain ideas have in common, I have made an idea that refers to ideas.

"I am putting the following into words: those ideas which do not refer to themselves. I make in my mind the idea that refers to those ideas, and I ask you, does this idea refer to itself or does it not refer to itself?"

Kohli rubbed the top of his head as he thought. "Does it matter?"

"Suppose proper action depended on it," I replied.

"Hard to imagine. The problem is all mixed up with words. If you could speak the People's language there would be no problem."

"Words, like plants and animals, are things a person should be able to control."

"Okay. I can't think of any idea that refers to itself. Your idea refers to everything I can think of. You can't imagine everything I can think of. You can't really have this idea. So there is no problem."

"Now, Kohli, that's not fair. I have the idea and I put it into words."

"Also, you mention a bunch of ideas without telling me what ideas they are."

"I describe them by telling you what property they have in common."

"Besides that, you can't have your idea until you've thought of the ideas it refers to, so it can't be a question of the idea referring to itself."

"You're begging the question."

"It begs itself. How can there be a question that mentions an idea that mentions the question itself?"

He was trying to run me around in circles. I think he was enjoying it, too. "Okay. When I convinced you that a person should be able to play with words, you began to play."

"You're sharp, for a human."

"Thanks." So I tried spacetime par-

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adoxes. "You know that we travel from star to star. Suppose you got in one of our ships, went to Aaron's World, and came back. You could do this in about twenty years. But it wouldn't seem like twenty years to you. It would seem like much less than that. Do you know about this?"

"Yes."

"Good. On the other hand, you would see your home planet moving very quickly, first away from you and then toward you. You would see the planet doing just what we on the planet would see you doing. So from your point of view, why is time speeded up on the home planet instead of slowed down?"

Kohli slapped his hands on the ground. "That's a good one! We both know that things happen faster where you are going, and slower where you are leaving. On the way back, I would see things happening so much faster here, that the twenty years would pass. The Home of the People is neither going nor leaving, but just staying, so there is no problem."

"Okay." His analysis resembled the traditional answer, so I posed another. "What about the tachyons the ship is shooting out? According to you, the ship's engines are emitting tachyons, but to us on the home planet, it seems like the tachyons come out of space and hit your ship. If you turn off the engines, the tachyons will already have stopped arriving. How can we justify this? The cause comes after the effect." I was on shaky ground with this one, though I knew that the answer somehow involved virtual particles and indeterminacies. I was curious to hear how Kohli would explain it.

"There is no problem. Everything that happens is cause and effect for everything else. Just as we can sit here and tell your tachyons far away what to do."

"That's how you stopped our ship!"

Kohli actually nodded. "We controlled your tachyons not to arrive."

After that revelation, I decided not to ask any more physics questions. I switched to pure mathematics. "Suppose a person wants to plant different grasses in certain yards, and the yards are separated by hedges. He wants to do this in such a way that when he crosses through a hedge, he will be moving from one kind of grass to another. How many kinds of grass will he need?"

"Whatever it takes."

"Suppose he wants to do it with as few kinds as possible."

"Then it would depend on the shape of the hedges."

"Well, he doesn't know ahead of time how the hedges are arranged. How many kinds of grass should he take, to be sure that he has enough?"

"Each yard gets only one kind of grass?"

"Yes."

Kohli thought for a few microans, staring out over the countryside toward the river. When his gaze returned to me he held up the fingers of one hand. "This many."

"You're sure?"

"It's very clear to me."

"To me, too," I lied.

So I tried a Smullyan problem. "Imagine a faraway place inhabited by

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keti birds, and some of them always speak the truth, while the rest always lie."

Kohli patted the ground again. "Those keti! Always up to something!"

I went on and on, giving all the conditions. ". . . each flock is named after some keti . . . a flock is called full if it includes its namesake . . . a keti is said to like a certain flock if he says that it is full; of course, he may be lying . . ." and so on. I set up Smullyan's model of Gödelian Incompleteness, analogous to the way he did it centuries ago in his opus, *What Is the Name of This Book?*

When I was done and Kohli had questioned me on certain points, he began to draw lines on the bare ground between us. I grew fascinated as the pattern became more and more complex. This was the Plexian analogue of our structural logic, and I was to learn later that I was watching one of their great formalists at work.

I had no idea what his design had to do with the problem, but I got the impression that this question was harder for him than the last one; for humans the reverse was true. With a short stick he drew marks here and there, guided by rules I had not yet fathomed. Some time must have passed, perhaps more than I was aware. Finally, the Plexian logician set down his stick, looked at me and gave me the answer. "No."

I hardly noticed. Something about the lines on the ground was giving me an inkling that yearned to be a hunch. The lines there were neither straight nor any particular kind of curve. Their function seemed to be merely that of connecting, not of showing colinearity.

I got my hunch and tried it, since I was running out of material. With one hand I reached forward and wiped out his pattern, with the other I picked up his stylus. "This is very interesting, what you draw. Tell me, what if you draw a design with straight lines, like this." I made my own picture. "This is called a triangle."

"The lines are not quite straight."

"Of course. But they represent straight lines. You must keep this in mind: all the lines in this picture are supposed to be straight."

"They represent the idea of straight lines."

"Yes. Now I'll mark a point that is supposed to be just as far from here as it is from there. If I draw a line from it across to this point, that's called a median. I'll draw all three medians. They always come together at this point, the centroid."

He studied my diagram for a while. He rubbed the top of his head and pulled at his mane. When he finally met my eyes, there was something forlorn about the way he said, "Always?"

"Yes. Always."

"How do you know?" Kohli asked me.

Then I knew I had him. I couldn't help what I did next. I put on my most affected smirk, and used my most pedantic tone, saying, "Isn't it obvious?" I continued, "And if I draw these lines . . ." I showed him the altitudes, and the orthocenter, and the perpendicular bisectors, and the circumcenter, and the Euler line, and by the time I did the nine-point circle—

He wasn't saying much. He just looked at me funny.

* * *

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Kohli's decision was inevitable, but he took his time anyway. I imagined that he and his advisors were off somewhere drawing triangles in the dirt, over and over, to see if the medians always met. I just sat there in the shade, reflecting on my good fortune. Apparently the Plexians had never gotten around to inventing classical geometry, one of the oldest and purest expressions of the human logical tendency.

While I waited I prepared a speech. For a day, I was the most powerful person on the planet, and I intended to make the most of that.

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Kohli came back with an entourage of other old Plexians. He took his place on the hide, and the others stood around us. "Simon Janov," he began. "It is now clear to us that humans are people. This is a very disturbing thing. It doesn't mix well with other things we know about you. We hope that somehow we will understand what is wrong."

His voice became quieter. "We are sorry about the mistake."

So I made my speech. "No, Khor Kohli, your mistake was not so great. Humans are not always people."

Our audience started chattering in their guttural tongue. I let them run down.

"All I have proven to you is that humans have the ability to be people. If you were to recognize the humans as people now, and allow them to continue the way they're headed, there would be a clash, and one race would not survive. The human colony must be controlled. This will mean controlling a few humans. They can be people, but not all of them have achieved this.

"Go to the human colony and explain to them who is in control here. The first time just warn them that the plants will die, but make no threats. After the plants die, go back and tell them about the ships. By this time, they will have discovered that the engines in the three ships orbiting this planet are not working either. Tell them the engines will go back on again if they destroy certain weapons which I will decribe to you. This might be especially effective if you wait until the fifth wave is almost here.

"When everything is under control

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in the colony, let the tachyons come to the engines again. Then recognize the humans one by one; let each prove himself in his own way. Call it granting citizenship. They will understand what you mean by that.

"Meanwhile, keep an eye on those humans. They're dangerous."

Kohli stared at me, with what might have been admiration. "You are clever, Simon Janov. This is a much better answer than the one we got."

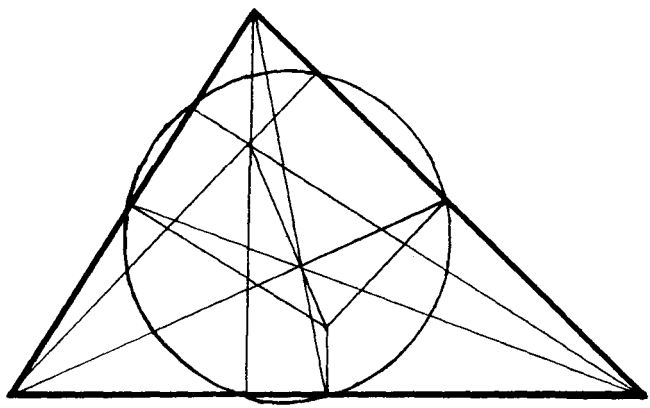
The last few years have been busy. I was often the go-between for the colony and the natives. As I expected, the priests eventually left us. Those of us who were more interested in belonging to a colony than in conquering a planet were left to govern ourselves. The Plexians gave us a site downriver for a city; it's growing, and I hear there are plans for a spaceport.

As sure as I am that I did the right thing, I sometimes ask myself questions. Did I have the right to exercise such power, to design a compromise without consulting my fellow humans? *Should I have agreed with Kohli?* Would a compromise have been reached anyway? And if not, who would have destroyed whom?

I think we have here a situation with a lot of possibilities. For the first time, in that branch of history about which I know, two intelligent species are sharing the same land. It makes me want to take a long starship journey, and return in fifty years or so.

I have more time to think now. Sometimes I work on figuring out the Plexian logic: it goes more easily now that I have their active cooperation. I think it's important that someone do this before we change them too much. We will change them some, and they will change us. For instance:

The Plexians have set up a monument in the center of their section of the city, a symbol of structure hidden within simplicity, a scalenely triangular slab of stone. ■



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brass tacks

Dear Mr. Schmidt,

I just read Brass Tacks in the May 1984 issue and am at last moved to reply to something. Or rather a couple of somethings.

Primus—"The Man Who Counts" was about Van Rijn having one survival skill: planning. In the situation it worked very well, but in a survivalist scenario, very few groups, at least initially, will be far enough above the subsistence level to afford the luxury of supporting a planner who is not directly productive. In the absence of others for whom to plan, Van Rijn would not have been helpless, but his danger and problem would have been far more severe.

Secondus—In a survivalist scenario situation, most of those emerging from the urban centers would, as they do now, rely on obtaining the necessities from others who already have them or can produce them. The means will of course be different, with far more emphasis on violence and threat. (Need I point out that for many New Yorkers this will not represent any change at all?) This is of course a temporary solution at best, lasting only till existing stocks are depleted. At this point everyone, even the overwhelmed producers, starve in the freezing darkness. The only exceptions to this bleak end will be those who have both prepared the necessities and some means of holding on to them. Please note that this does not necessarily mean minefields and machine guns. Even fairly close to an urban center, it is possible to site earth-sheltered housing along a little used or abandoned road, or one easily blocked in a way that seems the result of natural processes. Thus, the survivalist enjoys all the civilized amenities pre-disaster, and the starving mob that emerges from the nearby city simply never finds him.

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Regarding Mr. Marmor's assertion that New York is "target #1, we'll be gone in a flash." Aside from the fact that a strict counterforce targeting policy on the part of the Soviets seems more likely to me, which would result in New York's being left alone, there exist many studies, including those of the well known pro-disarmament journal, the Bulletin of the Atomic Scientists, which indicate that even in an urban center hit dead on by a megaton range weapon, it is certain that more than half of the population will not suffer any harm from any direct effect of the explosion, including primary and secondary radiation and debris. It is the tertiary effects, including disruption of transportation, law enforcement, and trade, which will kill most of those uninjured survivors by starvation and exposure.

Just as an aside, one of the most devastating lacks will be the medical resources, located so conveniently in urban centers, and consequently destroyed by the nukes. Think of how many lives could be saved in the immediate post-nuclear environment just by moving these, along with police and fire facilities, to the western outskirts of cities known to be potential targets. Modern transportation systems would make this a minor inconvenience in peacetime.

Tertius—must respond to Ms. Evans. I graduated a New York high school in 1964. There was no elite involved. Everyone, rich or poor, with the exception of the generally despised dropout, went to high school. College was where the non-elite were weeded out then. A few years later, the job interview became the place, till that was bypassed by affirmative action. Now there is no separation of the competent from the incompetent, let alone the elite from the generality. We are enroute to the world depicted in *Atlas Shrugged*.

The three-way division Ms. Evans suggests was in force then. There were separate programs leading to Academic, Commercial, and General diplomas, and the ratio was about 1:2:1. This division was abolished on the grounds of racism. The school I attended was segregated (de facto, not de jure) lily white, and had the same 1:2:1 as the all-black ghetto schools, so I never understood the racist tag placed on that particular program. I feel it is highly debatable that teaching no longer attracts first rate minds. I think teacher training and the choice of teaching methods (made at the administrative level) is more to blame. Viz; the use of the "graphic" as opposed to the "phonetic" method to teach reading.

MITCH GELLER
Durham, N.C. (former New Yorker)

Dear Mr. Schmidt:

I read your editorial, "Loyal Opposition" in the May 1984 issue and agree with you on only one point—the value of loyal opposition. I find your statements regarding the timing of such opposition extremely disturbing.

Speaker O'Neill is absolutely right. It seems to me that you have fallen into a trap many liberals have fallen into. We do *not* live in a democracy. We live in a *republic*. We are *not* the government. We control the government. The time to express our opposition is when we exercise control—at elections.

We elected Reagan, Bush, O'Neill, and Baker. We expressed our opinion. We trusted them with the governing of our country. In the late 1800's we entered the Spanish-American War be-

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cause McKinley bowed to public opinion. Now we have the ill-feeling of many nations we controlled during that imperialistic era to contend with. If Reagan backs down from military use of force because of public opinion then what will be the consequences 80 years from now? I say it is better for the President to rely soley on qualified opinion and his own judgement than to listen to Gallup polls or complaining liberals.

When we became entangled in Viet Nam, the government acted on its best judgement (hopefully!). A mistake was made, but I believe that it was made based on factual information and qualified opinion. As a general rule, the public cannot be regarded as well-informed except in hindsight. Public opinion, therefore, should only be regarded as valuable input in hindsight. Remember November. Voice your loyal opposition (or support) then.

The editorials I have seen have been interesting (although I disagree routinely) and I hope your quality stays consistent. Whatever your editorials say, I will never keep my many promises to drop my subscription with so many fine stories appearing each month. Way to go!

JOHN D. WILSON

Gulf Breeze, FL

I would never advocate that a government or anyone else hired to do a job bow to uninformed opinion, public or private, about how the job should be done. But sometimes the question is not the details of method, but the nature of the job itself: what is to be accomplished? In many cases that's a matter of preference or taste, and any employer has every right to keep his employees apprised of those preferences—and to expect them to act accordingly. It's essential, of course, that the employee (in this case, government) make a clear and accurate distinction between "goal" and "method of achieving."

Dear Analog:

I recently had the good fortune and pleasure of hearing Gregory Benford and Larry Niven speak on "Science Fiction and Science Fact." At the end of Mr. Niven's part of the program, he asked for opinions on why the general public has apparently lost interest in the space program. I suggested that many technical people I have worked with consider N.A.S.A. just another division of the Department of Defense. Without even, at least outwardly, considering the thought, Mr. Niven quickly decided that N.A.S.A.'s problem was in dwelling too much on boring technical details. Without question, there are a load of boring details in the space program's development, but if that were really a problem the excellent sales of the highly detailed "Shuttle Owners Manual" are difficult to explain.

Surely it is common knowledge, among SF writers, that our government has earned a poor record in the human rights, world peace, and fair development of the world's resources department. I suppose I should have expected this kind of response from Mr. Niven from the kind of treatment he gave Kurt Vonnegut in "Inferno." His disdain for the ideas in *Cat's Cradle* and *Slaughterhouse Five* are more from a Moral Majority rationale than technical criticism.

Some of your contributors are clearly making a good living dealing with the military applications of space. I suspect this clouds their vision somewhat. From reading their editorials and stories, it is

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obvious they regard themselves as part of the scientific elite, if not the leading edge. In my field, electronics, the best technicians and engineers are in the computer industry and at least some of the products developed can be used by humanity rather than against it. I suspect parallels in the other sciences exist. I personally know of a few quality engineers working in "low tech" fields such as solar energy, at least in part, to avoid conflicts of conscience.

The Jet Propulsion Lab in Pasadena, CA is becoming a focus of attention for this problem right now. Their operating expenses have been frozen for new development personnel in all but military projects. In 1984 20% of all J.P.L. research will be in military contracts. A recent N.P.R. report mentioned dissatisfaction among the scientific community at the laboratory regarding the new directions in research and the restrictions put on communications due to military security. At the very least, this will create a kind of segregation of technical personalities that the space program cannot afford. It will force the kind of person who has strong anti-militaristic convictions out of this area of research. I am not convinced that the right wing of science has any stronghold on technical excellence.

The space program has proven itself to be a source of innovation at least equal to war. This area of research is our way out of a lot more than the obvious problems of natural resources and the lack of a next frontier. It may also become an impassable prison wall if it is turned into a weapons staging center.

THOMAS DAY

Dear Mr. Schmidt:

In his April "Alternate View," G. Harry Stine makes several incorrect assertions to support the dubious conclusion that a new satellite navigation system, Geostar, proposed by Gerard O'Neill, is just what the world needs. He begins, dramatically, by asserting that the ill-fated KAL-007 flight had no back-up except dead reckoning for its three inertial navigation systems, leading somehow to its tragic navigational error: "In the north Pacific area there's no radar coverage, no Loran-C, and no Omega capability. . . . A back-up was available but couldn't be used: the US Department of Defense Global Positioning System (GPS). . . . GPS is a DOD system, and civilian airliners can't normally use it." Refutation of these statements may be found in published articles on radionavigation systems; there is a marvelous collection in the October, 1983, issue of the *Proceedings of the IEEE*, which is devoted entirely to global navigation systems.

Omega provides worldwide coverage and is used to supplement inertial navigation systems of several airlines and the US and Canadian air forces. Loran-C is not certified for this use, though the skywave Loran-C coverage along KAL-007's route would have been entirely adequate to guide it away from Soviet air space. (There are Loran chains in Japan and in the Aleutian Islands.) The GPS, while it is a DOD system, will be made available, at least in a reduced-precision mode, to all users, civil and military. The reason it is not available now is that it is an unfinished system. Only about six of the projected 18 to 24 satellites are now up, thus its coverage is spotty. GPS navigation receivers for civil users will certainly be sold by a number of firms.

The difference between GPS and the

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proposed Geostar system is that GPS transmits one-way to its users and requires a fairly "smart" receiver to determine each user's position. Geostar is a two-way (or, actually, a four-way) system which places a simpler (and presumably cheaper) transponder in the user's aircraft; the calculations are done in a big computer on the ground, and the system then sends back to the user, via the satellites, information on his position. The consequence is that there is a lot more transmitting back and forth, and much more radio bandwidth is needed, bandwidth which could better be used for other purposes. The bands which have been suggested for Geostar would cause interference to radio astronomy and eliminate these same frequencies from use in SETI, the search for extraterrestrial intelligence. (Here I must confess my own self interest, since I am a radio astronomer.)

The radio spectrum is a unique resource which permits many essential services. It should not be used unnecessarily for *any* purpose, even if it costs a bit extra to avoid such abuse. Actually, with the projected decrease in the cost of signal processing integrated circuits which should come about as the result of the DOD's very high speed integrated circuit project, it is projected that the cost of a GPS navigation receiver could be as low as $500 before the year 2000. This would seem to completely eliminate the need for another satellite navigation system such as Geostar.

ALAN T. MOFFET

Los Angeles, CA

Alan T. Moffet is dodging the issues I brought up in my Alternate View *column entitled "What Price The Human Life." He makes contentions, then shoots himself in the foot. For example, he admits that Loran-C isn't certificated for use on the Anchorage-Seoul route. He misses one of the main points: That one never proceeds in a potentially life-threatening activity without Plan B to fall back upon . . . and often Plan C and Plan D and Plan E as well. And the point that the DOD GPS system isn't operational yet, won't be operational for years, and requires an expensive airborne transponder. Maybe the GPS transponder will sell for $500 by the year 2000; is he assuming 1984 dollars? Has he priced avionic equipment lately? As for putting up with extra costs to avoid "abuses," how does he like paying extra for most applicances, professional equipment, and other gear because of the mandated "safety" equipment demanded by those stalwart protectors of our bodies and surroundings, OSHA and the EPA? Time was when people would be trained not to get hurt or killed using our technological tools; now we expect the government bureaucracy to do it for us. Rots of ruck, Charlie.*

He also misses the fact that Geostar works, works beautifully, is a digital system, and can't screw up the radio astronomy frequencies because anything that goes on the air is bound by international agreements and treaties regarding frequency allocation. We don't have to wait until 2000 to get a badly-needed satellite location/aviation system instead of a "multi-billion" dollar upgrade of the existing air traffic control system. A state-of-the-art satellite system can be put into place before the end of this decade at a reasonable cost. But not if scientists want to continue to study it to death. Back at White Sands during the rocketsonde days, we often had a smiliar problem. Project scientists would

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fiddle and tweak and diddle with their experimental equipment on board the rocket in hopes of getting a fraction of a percent improvement in calibration, for example. There arose a phrase that's still used today and that applies to satellite location/navigation as well: "Get them scientists away from that rocket and shoot it!"

As for Earth-based radio astronomers, when will they wake up to the fact that within fifty years there won't be any of them left on Earth? They'll all be in space where even the radio "seeing" is better. (I infuriate my astronomer friends when I tell them that Kitt Peak is going to become a scientific "ghost town.")

G. HARRY STINE

Dear Dr. Schmidt:

I have never written to *Analog* before, but the letter by Sam Elton in the June issue has shown me that a great danger exists and the world must be warned of it.

Reader Elton's experiments show that gravitational force doubles every time the temperature increases by 100° Kelvin. In mathematical terms, the apparent gravitational mass of an object at the temperature T is related to is true, absolute zero mass M by

$$M(T) = 2^{T/100^\circ K}\ M$$

As an example, assume my internal body temperature is average human, about 310°K. (We must always use the internal temperature of the mass in question). Since my scale tells me I weigh 78 kilograms, my true mass is 9 kilograms. This seems rather small, but everyone's true mass is reduced by the same amount. Since most things on the surface of the earth have about the same temperature, we can ignore the effect in our daily lives.

But now consider the sun. The sun's mass, as determined by the orbital period of the earth, is 2×10^{30} kilograms. The surface temperature of the sun is about 6000° K, so we'll use this as its average temperature. The true mass of the sun is then 2×10^{12} kg. Now the sun radiates about 4×10^{20} joules of energy every second, the source being the conversion of matter to energy. This means that the sun burns about 4000kg of (true, absolute zero temperature) mass every second. As a first approximation, let's assume that this rate is a constant. Then the sun has a lifetime of about 13 years.

This has very grave consequences. Since I clearly remember events happening over 20 years ago, my memory must have been tampered with. Obviously, the world was created just recently, and all of our memories adjusted so that we think otherwise. We must be an experiment by some outside agency. In view of the imminent death of the sun (certainly before the so-called year 2000 A.D.), our (very short) lives are in danger. Only by beginning to act now do we have any hope of being saved.

Seriously, the gravitational attraction between two bodies will increase with increasing temperature. After all, $m = \frac{E}{c^2}$, and temperature is just the expression of the internal kinetic energy of a body. The effect is very small. What is one kilogram of hydrogen at absolute zero actually weighs about .00002% more at room temperature. I suggest that reader Elton check his system for any possibility of convection currents being set up by his over. Any motion of the air inside his experiment would move the mirror enough to give him the readings he obtains.

MICHAEL J. MEHL

Beltsville, MD

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I share your strong skepticism, and Sam Elton knows it. I also have the opinion of a prominent gravitational researcher. The letter we printed was boiled down from a much bigger body of material. We consider it highly improbable that he's seeing anything more than the sort of experimental error you mention—but we're not in a position to rule out the possibility absolutely (though it does seem safe to say that his "doubling" rule couldn't hold over a wide range of temperatures, since it leads to just the consequences you mention). We doubt that he saw what he thinks he saw, but there is a small but nonzero possibility that he saw something *—and since this does seem to be a new experiment and is not likely to be published in any of the conventional journals, inviting others to support or refute it seemed a reasonable use of a few inches of column space in* Analog.

Dear Stan:

Right on in your response to Marilyn Durham in the February Brass Tacks, who took you to task for your lack of sympathy for the Tylenol murderer (and "nuts" in general).

Another major flaw in Ms. Durham's letter, which you didn't comment upon, is her statement that "these people are as tormented by their personal, internal hells as a human can be and still live." How one quantifies subjective experience, as she does so blithely, I can't imagine. I don't know—and I don't know how one *can* know, be he psychiatrist or no—that the "personal hells" experienced by individuals like the Tylenol killer are worse than the "personal hells" experienced by thousands of folk who nonetheless do not express themselves by random murders (or even as "mental illness"—by whatever criteria one defines that). As Thoreau remarked some time back, the mass of men lead lives of quiet desperation.

But in any case, even if the "personal hells" of such individuals are greater than undergone by other people, it may explain but does not excuse. Pragmatically, it doesn't really matter whether someone murders because of his "personal hell" or because of a perfectly rational, if amoral, perception of his self-interest, as with an armed robber. It's "transparent to the end user," as we say in the computer biz. Such behavior simply cannot be tolerated, regardless of its origin. As you said, we cannot pretend there is no important difference between such "sickness" and the common cold.

STEPHEN L. GILLETT, PH.D. ■

● The knowledge of truth as such is wonderful, but it is so little capable of acting as a guide that it cannot prove even the justification and the value of the aspiration towards that very knowledge of truth. Here we face, therefore, the limits of the purely rational conception of our existence.

Albert Einstein,
Out of My Later Years

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Jack C. Haldeman II

A VERY GOOD YEAR

The weirdest thing about this story is that it's *not* impossible!

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Last year was great for us. We've never had a better one and I guess we'll never have one like it again. Too bad. It was fun while it lasted.

I'm a senior statistician for the Department of Accident Prevention. For almost ten years I've been in the department, playing with computers and working my way up to GS-12. It's a great job. I just love numbers.

Accident Prevention is an obscure division of the United States Public Health Service. Most people have never heard of us, but they know what we do. Among other things, we're the ones who tell you how many people will die on our nation's highways on any given Memorial Day weekend.

We do a lot more than that, of course. If someone wants to know how many people were killed by falling objects in 1966, I'm the one to tell them. I've got all the facts right here in my computer. For the record, it was roughly 1500 people. And that's only counting the United States. That's a lot of falling objects. You'd think people would learn to look up.

I collect all kinds of neat things and used to be a real whiz at cocktail parties. Right in the middle of the *hors d'oeuvres* I'd come up with a winner like:

"Did you know strapping on roller skates is more dangerous than climbing into a top fuel dragster?"

Or:

"More people choked to death on hot dogs in 1976 than have ever fallen off of Mt. Everest."

Great stuff like that. Conversation stoppers and things to think about. I had a million of them. I just love numbers.

That's why it got to me when the numbers let me down. It all started during the holiday season last year, but we didn't know it at the time.

Every year just after Christmas all of us down here at Accident Prevention sit down with our left-over turkey and start plugging numbers into the computer. We look at all kinds of things. The amount of snow in Minneapolis is just as important as advance registrations to the motels around Disney World. If there's going to be a lot of rain or ice, we have to look at that too.

The New Year's weekend is the first big holiday of the year and predicting the deaths on our nation's highways for that four day period is no small matter. We like to get things off to a good start.

The economy plays a big part. If times are tough, people don't travel as much. Of course if they do travel, they travel by car, and it's probably an older model. It's a complicated formula, but we had it down pat. Or at least we thought we did.

The number we came up with was 972. It was a little high, but there was a low pressure system sliding over the Rockies, and Oklahoma was playing Notre Dame in the Orange Bowl. Lots of people traveling.

Of course we didn't all agree with the number the computer gave us. Bert had great faith in the developing cold front out of Canada and said it would be closer to 1000. Frank, on the other hand, thought that we hadn't given the price war between Delta and Eastern enough weight. He decided a lot of people would be flying to the Orange Bowl and the figure ought to be more like 950. Mable, the department's eternal optimist, felt people had learned their

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lesson over the near-record Christmas weekend and leaned more toward the 900 mark.

As usual, we each tossed five dollars in the kitty and taped our guesses on the computer. I picked 972. I liked the odds.

We had to wait until Tuesday to find out who won. As it turned out, we had all missed the mark. Missed it by a lot.

The magic number was zero. No one died.

I couldn't believe it. Nothing like this had ever happened before. This was one of our big weekends, and not even so much as a fender-bender anywhere. From the dirt roads in Bayport, Florida to the expressways of Los Angeles there hadn't been a single mishap; no driving errors, no mechanical failures.

The 4,572,643 miles of our Nation's Highways came away from the holiday weekend with a clean slate. And it didn't stop there.

For one thing, there weren't any suicides. Holiday seasons are a big time for suicides. The statistics prove it. Me, I don't get depressed until the bills come in, but not everybody feels the same way.

The entire four-day weekend passed with no plane crashes, no train wrecks, nothing. Not even a sledding mishap or two. There wasn't a fatal accident anywhere in sight.

The old Grim Reaper seemed to take a holiday. Nobody choked on any chicken bones. No one took a fatal spill on the ice or had a heart attack while shoveling snow. People were safe from falling objects and accidental electrocution. It was a great weekend for staying alive.

We were still arguing about who won the highway death pool or if it should be cancelled, when the updated hospital figures popped up on the computer. It was more of the same. No one had died in any hospital in the United States all weekend. That settled it. It was a fluke, that's all, a statistical anomaly.

Once in a while we get things like this. The first year I worked in Accident Prevention we had a big run on toasters. People were zapping themselves with toasters right and left. A week wouldn't go by that we didn't get two or three fatalities. The next year you couldn't buy a toaster death. Not a single one. The only thing toasters were burning was toast.

Over a period of time these things tend to even themselves out. That's what statistics are good for; they cover the bumps. Things like natural disasters and bridge accidents sometimes come in bunches, but in the long run it all works out.

We figured the deathless weekend would go down in the history books and statisticians would ponder it for years, but that was about it. It was a big fluke, but a fluke none the less. Sooner or later it would all average out. It was just a matter of time.

But time didn't seem to be cooperating any more than the law of averages. As January slid into February all we got was more of the same. It was driving the department crazy.

All our predictions were falling apart. National Firefighter's Week was a bust—no fires. Our figures on fatal accidents in and around the house had to be constantly readjusted. Washington's Birthday passed without a single fatality, automotive or otherwise.

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By April things were getting out of hand. Insurance companies were hounding us for updated life expectancy tables and we didn't know what to do about it. No one was dying. They were making money hand over fist and all we were getting was confused.

Lots of people were upset. The American Cancer Society was almost bankrupt. The National Heart Association was in dire straits. With nobody dying of cancer or heart attacks, it was hard to collect money for these worthy causes. Even the National Safety Council was in trouble. Auto repair shops were closing in droves. Hospitals were at loose ends and operating at a loss. There were, of course, no vital organs being donated. None seemed to be needed, either.

For Memorial Day we finally went out on a limb and predicted that there would be no traffic deaths that weekend. For once we hit it on the nose.

It was a complicated mess, but really very simple. It didn't take an expert on probability theory to figure out what was happening.

Living and dying has always been a matter of beating the odds. Ask any insurance salesman or doctor: it's true. You pay your money and take your chances. All you have to do is beat the odds. Usually it's not easy.

If I have enough information on any given living person I can come up with the odds on their dying. All I do is punch the data into the computer and see what pops out. It doesn't matter if I'm looking one day into the future or fifty years. Death is like any other thing to a computer: just a bunch of numbers.

Suppose I punch in John Doe, age 40. Say he's a pretty healthy guy who doesn't race cars or fly on non-commercial aircraft. Besides that, he's a non-smoking jogger and takes one aspirin a day. Even with all that going for him, the odds are 99.9% that he'll die within 50 years. I wouldn't bet against odds like that.

On the other hand, death is a two-sided coin. You're either alive or dead, all or nothing. It's kind of like flipping a coin; heads you live, tails you die. For John Doe, there's one chance in a thousand the coin will come up heads and he'll beat the odds.

A lot of coins were coming up heads.

Things really started to fall apart after the accident-free Labor Day weekend. Morticians went out of business and turned their funeral homes into ice cream parlors and pool halls. Ambulances gathered dust. Casket and tombstone manufacturers filed for bankruptcy. Doctors played a lot of golf and dabbled in the erratic stock market. The grave diggers went out on strike and nobody noticed.

It was a great Christmas. Things were getting a bit crowded what with nobody dying and lots of people being born, but hardly anybody cared. It was a festive holiday season. It was the *last* festive holiday season.

At the stroke of midnight on New Year's Eve 8,456 people were killed by flying champagne corks in Boston alone. The national figure was, of course, much higher.

In New York 12,893 people were smothered by flying confetti, 32,032 people choked to death on finger food, 9,235 fell from high places, 4,204 people found themselves under falling ob-

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jects, 7,365 unloaded guns were loaded. There were 53,964 fatal heart attacks, 23,603 strokes, and a whole bunch of sudden brain tumors. Three bridges collapsed, fifteen ocean liners sank in port, 4,572 people slipped in the subway and fell on the third rail. There were 34,785 automobile accidents within the city limits involving 47,532 fatalities. All this happened before the sun came up on the first day of the new year.

Before the week was out things had gotten worse. Most of Southern California was wiped out by tainted food. The Pacific Northwest suffered an epidemic of terminal gout. The entire adult population of Enid, Oklahoma fell off of ladders on Saturday afternoon without a single survivor. Accidents and disease were rampant all over the world. We were beginning to suspect a trend.

A lot of coins were coming up tails.

People were dying so fast we couldn't keep up with them. My computer was suffering from information overload. Before January was over there were a lot more people dead than alive. I thought it would stop, or at least slow down. It didn't.

My computer estimates that there are, as of 8 A.M. this morning, three people left alive on the planet, plus or minus the usual five percent. Of course that includes me and I'm taking things real careful. The computer gives me odds of .0001% to make it through the year and I'm not doing anything to press my luck.

Although I'm dirty and I stink, for instance, I'm not going near a bathtub. Bathtubs are very dangerous places.

The statistics prove it. ■

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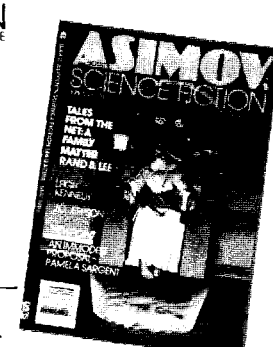

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The Alternate View

THE MILITARY RATIO

G. Harry Stine

In most of the rest of the world, a nation's military forces are viewed somewhat differently than they are in the United States of America. In the USA, military power is seen as a necessary evil which must be kept small, impoverished, and totally under the control of non-military civilian politicians. Much of this derived from the founders of this nation who, being educated men and students of history, knew only too well the dangers and hazards of having powerful military establishments within a state, often for internal use by politicians as national police forces. We see too often how national military forces are used for internal purposes in other countries. So did the founding fathers.

Among ourselves in the USA, there's a tendency to consider the nation to be over-militarized right now. But what does "over-militarized" mean? What's the history of the relative size of military forces in various nations over a period of time? And can we hang some numbers on this? The definition of the term "over-militarized" will depend on how each of us assigns priorities. But it's possible to trot out briefly some of the history and to come up with some numbers that may or may not let us know whether we've assigned the proper priorities. Both the history and the numbers may surprise you.

Our culture has a near-term Europocentric background due to the preponderance of our citizens whose progenitors were immigrants from that part of the world. There has been a great deal of oriental and afro culture introduced and assimilated as well. However, on the military question, there is no doubt that our background is Europo-centric. Science fiction itself is full of it. Most tales of future civilizations here or elsewhere contain distortions of it; especially in the sword-and-sorcery class.

Our military heritage comes from the Middle Ages of Europe. Armies weren't very large. Armies cost money that kings could and usually would spend on themselves and their courts. The number of professional soldiers retained in times of peace was rarely greater than a hundred or so. Some of these provided a personal bodyguard for the monarch and the royal family. The remainder garrisoned a couple of the most important royal fortresses, especially where such redoubts commanded a trade route and the garrison could therefore demand a toll for their "services" in "protecting" the merchant who wanted to pass unmolested. In times of military crisis, the European nations of Christendom relied for their defense on the obligation of all citizens, coerced in various ways, to take up arms in defense against the invader, whether that invader be neighbor or infidel. And there have always been plenty of infidels knocking on Europe's doors. As recently as 1918, the

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infidels were the Ottoman Turks. Today, the infidels are slightly different but they're still out there in an easterly direction with hordes and hordes of men, tanks, aircraft, and ballistic missiles.

Basically, the USA has retained this deep-seated feudal military philosophy: Keep the army lean, small, and poor in peacetime to keep costs down. Depend upon conscription in times of national emergency when it becomes necessary to expand the army rapidly. To this, Americans have added a unique restraint: The military forces are *always* under the control of civilian bosses. Always. In spite of a number of sensationalistic novels twenty years ago about hypothetical military takeovers of the federal government, there have been no military coups in the USA. This has not been true elsewhere in this hemisphere, to say nothing of the rest of the world. And civilian control has often posed difficulties in conflicts such as Korea and Viet Nam where civilians tried to call the tactical shots from comfortable offices on the Potomac.

Even in times of war, European nations in the Middle Ages fielded armies that would be considered small today. They were rarely more than 15,000 to 30,000 men. Armies are expensive.

Then in the sixteenth century military technology made possible the gunpowder firearm. This demanded far greater professional military expertise to use than the classic spear and pike. Larger armies were required because it was impossible to train arquebusers in a hurry. Or get the required discipline even if the farmers knew how to load flintlock smooth-bore shoulder-fired guns.

But was the increase in the size of standing armies due to technology or to a discovery of management techniques that made a large army possible? Or a rediscovery of these techniques? Probably the latter, and the latter of the latter.

It might be helpful at this juncture to look at some history. What has been the ratio between the population and the number of soldiers maintained in a standing army by a nation? Surprisingly, it seems to have had nothing whatsoever to do with technology but with (a) management know-how, and/or (b) finding ways to get into citizens'

TABLE I

Nation	*Population*	*Standing Army*	*Soldiers per 1000 people*
Rome (4th century)	c.50,000,000	350,000	7
Ottoman Empire (17th century)	c.25,000,000	180,000	7
France (17th cent.)	19,000,000	150,000	8
(1832)	32,500,000	350,000	10
(1962)	46,500,000	415,000	9

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pockets to support the standing army.

Table I shows the data for the Roman Empire at its 4th century peak, the feared Ottoman Empire at its peak in the 17th century, and three data points for France.

By and large, the historic and current "military" ratio of soldiers per 1000 people for a nation falls between an average of 7 and 10.

How about modern nations? Data can be found in the current *World Almanac and Book of Facts*. Table II shows a few of the most obvious nations we often consider as being either militaristic, non-militaristic, or as potential adversaries in a military confrontation.

Surprised? The most militaristic nation in the world turns out to be Switzerland with 91.4 soldiers per 1000 Swiss. No wonder none of their neighbors even considers invading them! And

TABLE II

Nation	*Population*	*Standing Army*	*Soldiers per 1000 people*
Switzerland	6,343,000	580,000	91.4
Israel	4,000,000	165,600	41.4
Libya	3,100,000	49,000	15.8
USSR	268,800,000	2,700,000	10.0
East Germany	16,800,000	163,800	9.75
France	53,900,000	472,226	8.76
West Germany	61,200,000	495,000	8.1
United Kingdom	55,901,000	327,100	5.85
P. R. China	1,004,000,000	4,390,000	4.37
U.S.A.	226,504,825	762,739	3.37
Canada	24,343,181	79,549	3.27
South Africa	29,000,000	81,300	2.8
Japan	3,100,000	49,000	2.05

all along we thought it was either the difficulty of the terrain or the universal Swiss military training with their huge citizen reserve. It also means that the Swiss have worked out ways to pay for a standing army that's large in proportion to their poulation.

As for the high ratio of the Israelis, they have enemies staring at them over every border. But does this necessarily hold true for Libya?

The USA compares rather well in its generally low military ratio viz-a-viz the western European nations, the USSR, and the People's Republic of China. We're quite on a par with Canada.

Does the military ratio tell us anything about the philosophy or intentions of a nation? I don't know. Sounds like a good doctoral thesis. Maybe any sort

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of an answer might tell us more about how and why wars are started, won, or lost. Or why we should or shouldn't maintain a large standing army.

The data generally refer to peacetime standing armies. In wartime, the ratio is different and can tell us something, perhaps, about the military ratio when it's a do-or-die all-out general war. Can we come up with what our USA ratio has been in various wartime situations? Yes; the data is shown in Table III.

From the point of view of the percentage of our population involved, it looks like we've had three Big Ones when about 5% or more of our population (military ratio 50 or greater) have been part of the military service: the Revolutionary War, the Civil War, and World War II. Otherwise, in some wars it's been business as usual for the feather merchants back home while the grunts hit the mud somewhere else.

TABLE III

War	*Population*	*Involved Troops*	*Soldiers per 1000 people*
Revolutionary War	3,929,214	184,000	46.83
War of 1812	7,239,881	286,000	39.50
Mexican War	17,069,453	78,718	4.61
Civil War (Union)	31,443,321	2,128,948	67.71
Spanish-American War	75,994,575	280,564	3.69
World War I	105,710,620	4,057,101	38.4
World War II	135,000,000	11,260,000	83.4
Korean War	151,325,798	2,834,000	18.7
Viet Nam War	203,302,031	4,368,000	21.5

Right now, the USA is on the low end of the military ratio scale. There are only 3.37 soldiers in the standing army per 1000 population, a mere 0.337%. But what does this mean? Are we doing a better job with fewer soldiers? Unlikely; it takes just as many Chinese and Russian infantrymen to hold ground as it does American GIs. Are we not using as many for internal police purposes? Probably, judging by the way many other nations use their standing armies in peacetime. Are other nations getting ready for war with us, and does it show in their ratio? Probably not, because none of them who might be adversaries have a ratio anywhere near what the USA had in Korea or Viet Nam. Or are the other high-ratio countries putting their hands deep into their citizens' pockets for the taxes to support these high standing army ratios? Probably.

I found this exercise useful in giving me perspective. It also gave me an alternate view of some current national and international problems. Maybe the military ratio is useless as a decision factor. Maybe not. But it's interesting.

And with a subject as important as war, every bit of data about it has to be treated as useful at some point! ■

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Lots of people dream of fame, unaware of the problems it would bring. Of course, with cleverness, even those might be overcome. . . .

THE LIFE OF BOSWELL

Jerry Oltion

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"If you can look into the seeds of time
And say which grain will grow and
which will not . . ."

Macbeth, I, iii

She came into the room like sunlight from behind a cloud. I was sitting about halfway back and next to the aisle, thumbing idly through a *Playboy* magazine while I waited for class to begin, when I noticed her in the doorway. I saw a cascade of blonde curls falling down over the shoulders of a bright yellow ski jacket, framing a face with wide, inquisitive eyes and cheeks flushed with that surge of color that comes from running the last few blocks to class. Melted snowflakes sparkled in her hair.

She scanned the room the way most people do on the first day of class, looking for someone she knew, and for just an instant as our eyes met I realized that that someone was me. The merest flicker of her eyes was all that betrayed her, but it was enough. She looked on toward the back of the room and I looked back at my *Playboy*, but neither of us was fooled. I tried to remember where we might have met, because in that moment of contact I had felt that I knew her too.

I looked up again and caught her looking back at me, and I felt it again. *I know you*. She reached down to tug on her coat zipper, and though she caught the runner in the hem, the suggestion was enough. Now I knew why I recognized her. It didn't answer how she knew me, though, because except for this month's centerfold I was pretty sure I had never seen her before.

She started up the aisle, still tugging on her zipper. By the time she came alongside me I had worked up enough courage to lean out and say, "Here, can I help you with that?"

She froze the way people freeze when they see the train coming straight for them, or when the earthquake hits: terrified, unable to think. I was about to ask again when she stuttered to life and said, "Oh, no, that . . . that's all right, I, I've almost got it, thanks," and fled on toward the back.

I straightened up in my chair, then self-consciously checked my fly. Zipped. No spinach hanging from my teeth, either. I had showered that morning, shaved, put on freshly laundered clothing—everything it takes to make a person socially acceptable. I am not conceited, but neither am I ugly. So why had she run away?

I heard a chair squeak a few rows behind me, and I felt her eyes on my back.

Another girl came in and sat in the chair in front of me, giving me something more pleasant to think about. She wasn't the centerfold type, but she was nice looking in her own way. Her hair was brown and straight and long enough for her to sit on, and she had dark eyes and freckles and wide, full lips. She wore Levis and hiking boots and she carried her books in a backpack that looked like it had seen some use. She smiled at me as she pulled her hair to the side and let it spill over the back of the chair to hang in front of my knees.

The instructor came in and began to write the reading list on the blackboard. The class was eighteenth century English literature, and as I copied the list into my notebook I felt the beginnings of a deep despair that I knew I would

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feel all semester. It was the standard fare for an eighteenth century lit class: Pope, Goldsmith, Gray, Burns, and a slew of lesser-known poets. The one prose selection on the list I knew by reputation, and it was no better. James Boswell's *Life of Johnson*. I had read excerpts from it in other English classes, and without exception it had bored me to tears.

I felt the familiar doubts returning. What am I doing studying English? What's the point? I wanted to be a poet, and I had originally thought that the best way to do that would be to study the old masters, but with each passing semester I doubted the wisdom of that choice more and more. I wanted to write relevant poems, poems that people could read, not the incomprehensible puzzles of the past. Studying them only showed me what not to do. Once again, as happened every semester, I debated changing my major to physics.

Too late, I told myself. You're only half a semester away from your B.A. Finish the job at hand first, because if there's anything worth less than an English degree, it's half an English degree.

I became aware that the girl in front of me was searching through her pack for a pen, without success. The memory of my first gallant offer of the day was still with me, but I decided to risk a second try. I cleared my throat and whispered, "Would you like to borrow mine?"

She turned around in her chair, smiled and blinked long lashes at me, and said, "May I? Thank you," in a way that made me feel like Sir Galahad himself. Now *that's* more like it, I thought.

* * *

We both settled back to listen to the instructor give his standard opening-day rap about the class. After a few minutes I revised my assessment of it. It might be bearable, at least. I am the sort of person who can be infected with excitement fairly easily, and this man was obviously very excited about what he taught. When he talked about one of the poets, he spoke as if that person were still alive and had just stepped out of the room for a moment. Not "Pope said" this or that, but "Pope says." A detail, I know, but it was reassuring. Some people really *could* enjoy this stuff.

Class was short, as first day classes usually are. I found myself standing amid the crowd in the hall with a half hour to kill, watching the girl who'd sat in front of me make off with my pen, walking slowly. I could have taken it as an invitation. I had almost decided to when I noticed the other girl, the blonde, standing by the front doors and watching me over the heads of the crowd. She looked away when our eyes met, and stepped outside.

I know when someone is interested in me. It's not possible to fake it, and it's not possible to hide it, and I saw it in her eyes. I had to know why. I could get my pen back later, but this wouldn't wait. I pushed my way toward the door, trying to keep her in sight, and crashed into someone coming in. My notebook and magazine fluttered to the floor, and so did his. He stopped to pick them up, handed me mine while we both muttered, "Sorry," and turned to go. But I saw his face first. I could have been looking in a mirror.

"Hey!"

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He didn't turn around. I considered grabbing him, but I didn't know what I'd do if I was wrong. Come to that, I didn't know what I'd do if I was right. So I just stood there and watched my reflection walk into the building while I tried to convince myself that I was mistaken. It was easy to do. How often do you meet yourself at the door?

I mean *really*.

Coincidence, I told myself. He's got the same coat, that's all. You saw that and made the rest of it up.

And the same shirt, and the same pants, and everything. I made a mental note to quit buying my clothes at K-Mart, then turned and stepped out into the January cold.

The snow was coming down heavily enough to make everything more than a few feet away look like a scene in a grainy photograph. I had to look hard before I recognized her, walking alone, just turning the corner behind the physical sciences building. I jogged to the corner and about halfway down the length of the building before I caught up. She turned when she heard me behind her, and I realized that I had nothing to say.

I stopped a few feet away and said the first thing that came to mind: "I'll never get to sleep tonight if I don't at least know your name."

A half a second can be a long time when you're waiting for a girl to tell you to get lost. I waited while she thought it over, waited while her face betrayed something like panic and she fought it down, waited still more until she let a hint of a smile show through and said, "Kristina Hunter." It all took just enough time for me to hold in my breath.

I let it out and said, "Michael Waggoner. Can I buy you a cup of coffee, Kristina?"

"We . . . I shouldn't."

"Tea then. Or hot chocolate."

That brought a genuine smile. "It's not that. It's just . . . we shouldn't be together."

I held my arms out to include all our surroundings, vanishing into the distance, and us in the center of it. "We already are," I said.

I expected her to say something about her boyfriend or her husband and politely excuse herself. She was full of surprises. Instead she hugged herself tight, closed her eyes, and said, "We are!" She opened her eyes. They were green. "It's already too late," she said. "Sure, let's go."

I did not ask "Too late for what?" I probably should have; it would have saved some trouble later, but I already had a million questions I wanted to ask and that one wasn't anywhere near the top of the list. I asked instead, "Have we met before? I know that sounds really cliché, but I get the feeling that you already know me."

"By reputation only," she said.

"I didn't know I had one."

"Oh yes. You're very famous, actually."

"For what?"

She bent down and scooped a handful of snow. "That would be telling." She blew on the snow and watched it swirl away. "Isn't it beautiful?"

"It is." *And so are you*, I thought. "And so are you," I said, and held my breath again.

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She had me mystified. I had no idea what to expect from her; a smile or a slap in the face. She gave me neither. She said, "I didn't think you liked blondes." *Then* she smiled.

"My reputation again?"

"Mmm hmm."

"I think you know more about me than I do."

"I'm sure I do."

Curiouser and curiouser. I decided to change the subject. "So what else do you study, besides me?"

"I'm a history major, if that's what you're asking."

I smiled. "Studying the eighteenth century?"

She shook her head. "Nope. My era is the twentieth. But I am interested in literature."

The student union resolved out of the swirl of snow. "I didn't know you could do that," I said, opening the door for her.

"Do what?"

"Study history in progress."

"It's the best way."

We got hot chocolate in styrofoam cups and sat at a table next to the window where we could look out and watch the snow.

"Think about it," Kristina said. "The twentieth century is a turning point in the history of the human race. Right now people are making decisions and doing things that will affect us thousands of years in the future. What better time to study it than when it's happening?"

"Hmm," I said. "Good point. But how do you know what's important and what isn't?"

She smiled a smile that means *private joke*. "Twenty-second century history books," she said.

"Ah." I tried to think of something to follow that, but her smile was too distracting. So I finally said, "So are you ready for this lit class?"

"I think so. How about you?"

"I don't know. I think I'm getting burned out on English. *The Life of Johnson* doesn't really send shivers of excitement running through me."

She laughed. "Should it?"

The way she asked made me laugh too. "I used to think so. Honest, I did. When I first started taking English classes I thought it was going to be the most fascinating thing: studying all the old masters. You know, becoming 'educated.' But after a while I guess you start to wonder what you're going to do with it, and that takes all the fun out of it." I looked out at the snow and at Kristina's reflection in the glass. "What can you do with an English degree? I mean, where's the practical application? You study all these people from the past and you write papers about them, but for what? So other English students can study what you wrote and write papers on *that*, and it goes on and on. It's Boswell writing *The Life of Johnson* all over again, but what did Boswell ever do with his own life?"

I looked back inside, and I could tell I'd said something wrong. "Sorry," I said. "I sometimes start to preach."

She shook her head. "No, no, that's all right. I just—I never thought about it that way. But why do you stay with it if that's the way you feel?"

It was an automatic reaction, my blush when I said, "I want to be a poet."

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Her eyes started to sparkle again. "Really? Can I read some of your poems?"

I don't normally skip classes on the first day of a new semester. But then, I don't normally meet girls like Kristina, either. She seemed more excited about my being a poet than I was, and after I showed her the only poem I had in my notebook she practically invited herself over to my apartment to read more. She didn't have to ask twice.

I lived on the top floor of a three-story building, in a one-room apartment that I had affectionately nicknamed the garret. The fact that it *was* a garret didn't diminish it in my eyes at all. It was roomy enough for one person, high enough to have a view, and quiet enough to write in. That was all I needed.

Kristina loved it. The way she went around oohing and ahhing at everything, looking at all the posters, even sitting at my desk, reminded me of a person looking to rent the place. Or maybe someone in a museum.

I let her pour a couple of glasses of wine while I dug out some of my better poems, and we sat on the edge of the bed to read them. I'd wondered if she'd just been after a quick invitation home with me, but that wasn't so. She really did like poetry. *My* poetry. She made me read it aloud, and she was the best audience I ever had. She laughed at the funny lines and she was serious for the serious ones and she didn't make me read the sonnets twice to understand them. She made me read them twice because she liked them.

We read and talked and laughed away the rest of the afternoon, neither one of us caring about the classes we were missing or anything but the fun we were having together. When it started to get dark I got up and turned on the light over the desk, then reached for the phone and dialed from memory. While it was ringing I asked, "What kind of pizza do you like?"

She looked up from the notebook in her lap and said, "Pizza? Oh, I don't care. What do you like?"

"Everything but anchovies."

"Me too."

So I ordered a pizza with everything but anchovies and asked the delivery boy to stop off for beer on the way. With a sort of recklessness that was part drunkenness and mostly inflated ego I sat back down beside Kristina and composed a few impromptu lines about blonde hair and green eyes. After that we didn't talk much about poetry, or anything else.

The pizza arrived too soon. I cursed and untangled myself while Kristina laughed and kept tangling me up, but I finally got loose, paid the delivery boy, and came back with pizza in one hand and beer in the other. Kristina was looking through my *Playboy* magazine.

I set the pizza on my desk, opened a beer, and held it out toward her. I said, "I'd claim that I bought it for the fiction, but that wouldn't be true."

"Oh?"

"I, uh, I like the centerfold."

All innocence, she turned to the middle, opened the gatefold, held it out sideways, then vertically. I dropped the beer when she shouted "Grandma!"

I chased the foaming bottle under the bed, righted it, and said, "What?"

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"That's my—" She looked at the signature on the picture, said, "I have a cousin—" and stopped again.

"That's not you?"

"No! It's, um, it's . . ."

"Your grandmother?"

She looked up at me with those wide green eyes of hers for so long that I thought I was going to have to kiss her just so I could blink. Finally she looked away and said, "I guess it doesn't matter anyway. It hasn't mattered since you followed me out of the classroom building. Yes. Yes, this is my grandmother."

I put two pieces of pizza on napkins and handed one to her. I realized that she was waiting for a reply, so I said, "She wears the years well."

Kristina said, "She's younger than I am."

"How's that again?"

"It's true! It's not that complex, really. You see, I'm from 2137."

"Oh," I said, and took a bite of pizza.

"The year," she said helpfully.

"I think I liked the one about your cousin better."

She gave me an angry look for a few seconds, then stood up, lifted her shirt to just under her breasts, twisted what might have been a dial on what might have been fishnet underwear, and vanished.

I stood there staring at empty space for about half a minute while I waited for the flash of reasoning that would answer everything in my mind. Nothing happened. I reached through the spot where Kristina had been standing. Air. I resisted the urge to look under the bed.

So where was she now? Or *was* she now? It sounded like she'd been talking about time travel; perhaps she'd gone to some other time. Could she have?

I knew of nothing that could make a person vanish in an instant. I knew nothing about time travel. But it didn't necessarily follow that vanishing in an instant implied time travel, did it? That sort of syllogism is invalid.

But an invalid argument can still be true. *Something* had certainly made her disappear.

If there had been anything else to do besides wait for her to return I would have done it, but I couldn't think of a thing. I thought about calling the police, but decided against it. If they bothered to investigate at all they would be investigating for drugs. A disappearing girl? Uh huh. I hardly believed it myself. I needed more information. So I sat down on the edge of the bed, careful not to occupy any of the space she had so recently filled, and waited. Since I still had half a beer in my hand, I drank it, and opened another.

If half a second can seem like a long time, try ten minutes. I had nearly given up hope of ever seeing Kristina again when she suddenly returned. No rush of air, no flickering; she was just there, standing exactly as she had stood when she left. She lowered her shirt and said, "There. Now do you believe me?"

"Where . . . ?" I asked weakly.

"I went forward in time. A demonstration is much more convincing than talk." She took a bite of pizza and said around the mouthful, "Sorry it took so long, but ten minutes is the minimum increment."

Forward in time. Had she really? I thought about it for a second or two,

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then reached out for her pizza. "May I?"

She relinquished it with a frown, eyeing the box on the desk and my own slice beside it, already on a napkin. I held the wedge in my hands and felt the heat of it through the napkin, then gave it back to her and picked up mine. It was cold, the way pizza should be after ten minutes out of the box.

"You didn't by any chance stick that in a microwave oven, did you?"

"No."

"I thought not." Forward in time. I felt myself beginning to believe it. Beginning, hell; I was convinced. "So tell me about it," I said.

"There's not that much to tell. I really am a history major, and I really am studying the twentieth century. I'm also a research assistant. I'm here to gather information for a book on one of the most important people of the era."

"Who?"

She smiled wide and giggled. "You."

I waited for the sales pitch. It was a reflexive reaction. First they flatter you and then they try to sell you magazines.

"I'm not kidding," she said. "You're going to be famous."

"Famous for what?"

She picked up a notebook and shuffled though the pages. "These. Here, this one, and more like it. You're going to write a book of poems that will be published two years from now. It will sell a hundred thousand copies in its first year. In five years you'll be the best known poet in America."

"Come on; people don't read poetry any more."

"Yours they will. You're the start of a literary renaissance that's still going on in my time. Because of you the next two centuries are an age of art and intelligence."

I could feel the edges of my ears turning red. "Let's not get carried away here," I said.

"Oh, but it's true! It started out as kind of a fad, reading poetry, but it started a movement in the right direction, and after people learned to think they couldn't very well go back to being the way they had been before. At least that's Dr. Hohenzen's theory."

"Hohenzen?"

"He's the person writing the book. He's going to call it *The Life of Waggoner*. He's considered the world's foremost authority on you."

"Oh," I said. "He's a fan, eh?"

"You could say that. He's even had surgery done so he looks like you."

"You're kidding."

"I'm not."

"And he knows everything there is to know about me?"

"Just about."

"What if I don't do it? What if I don't write any more poetry? Say I go to Wyoming and work on an oil rig or in a coal mine for the rest of my life. What then?"

Kristina shook her head. "You can't. You won't. You *didn't*. Michael, I grew up in a world that had you in it as a major literary figure. It's *there*, real and solid. I could show it to you. It's already happened."

"It hasn't for me. What if I *do* decide to work on an oil rig? What's to keep me from doing it?"

Kristina lost some of her smile. "The time patrol," she said.

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"The time patrol?"

She nodded. "They're in charge of keeping things the way they ought to be. Time is fairly resilient; it allows for minor changes, but every now and then with so many people moving back and forth in it we do get changes that affect the future. Mistakes, people interfering with important events either by accident or on purpose—whatever. The time patrol monitors the course of reality and steps in whenever they detect a diversion."

"What do they do then? I mean, they can't force me to write poetry."

"They don't need to. They simply remove everything that causes you not to."

"Like what?"

"Like me. Like this conversation. Michael, you were never supposed to meet me. You never did, really. This conversation doesn't exist."

"It does! We're having it!" I admit to being a little excited. Unreal conversations do that to me.

Kristina looked less than happy herself. She said, "I'm worried about that too. We should have been edited hours ago, when you didn't make a date to go to the movie with your wife."

"Huh?" I said. "Wife?"

"Future wife, I should have said. Remember that girl who sat down in front of you today? The one who took off with your pen? You should have followed her and got it back. You would have invited her to a movie, starting a relationship that would lead to marriage in another year and a half. She's a very domineering sort of person, responsible for nagging you into doing some of your best writing. That's an important part of your life that hasn't happened today, and somebody should have noticed it. The time patrol should have stepped in by now."

"But they haven't," I said.

"No, they haven't. For some reason they're letting it go on this way for a while."

"Gathering evidence against you?" I asked. "Maybe they plan to prosecute you for changing the past."

"Don't be silly. I *haven't* changed it. And the time patrol doesn't prosecute; they just repair. Michael, you have to understand, none of this ever happened. You *will* make a date with Caroline tonight, and you *will* go to the movie with her, and you *will* marry her, and you *will* write a book of poetry and all the rest of it."

"I *won't!* I chased after you instead, and now it's all changed. This is real!"

"It isn't. I'm sorry, Michael."

I took a long drink of beer. Or did I? Who else was drinking this same bottle of beer tonight? I set the bottle down on my desk. "This is nuts!" I howled. It wasn't quite a scream.

"It's a paradox, yes, but the time patrol will clear it up."

"So you can go back to watching every move I make for the next fifty years? No thank you."

"Ninety," she said. "You live to one hundred and twelve."

That time I did scream.

"Michael!" She sat down and put her arms around me and said, "I'm sorry. I didn't think. That's one of the things a person shouldn't know about himself."

"You miss the point," I said after a few deep breaths. "I don't care how old

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I live to be. What matters to me is that I don't have any privacy or any free will. You've got every event in my life all mapped out in detail, and you write papers about how it all goes together. You watch me pick my nose and go to the bathroom—and maybe worse, hmmm? It's like being in a play! You follow along in the script, a script that gives me no choice at all, and the one time that I do ad-lib a line you call the director and make me re-do the whole scene!"

I hadn't meant to shout, but now Kristina had tears running down her cheeks as she said, "Oh, Michael, it's not that way. We do watch you, I admit, but we don't make you do anything. Your life is exactly the way it would be if we weren't here at all. It's only when we make a change that the time patrol steps in. They're protecting us both."

I said something I don't normally say in front of girls.

"It's true! If the time patrol didn't keep things on track, reality would be changing back and forth all the time. You'd have all sorts of people trying to shoot Hitler, trying to shoot Jesus—the works. Niven's law would eventually prevail."

"Niven's law?" I asked.

She nodded. "Larry Niven. He's a contemporary writer. Contemporary to you. He didn't even think that time travel existed, but he predicted how it would behave. He basically said that if you have time machines messing up the past, eventually they'll change it to the extent that no time machines will be invented. That's the only future that's sure to be stable, you see? So we have the time patrol to keep that from happening. They protect us by protecting you."

"What's wrong with letting Niven's law protect me?" I said. "At least that way I wouldn't have people looking over my shoulder while I pee."

"You might not be here at all, that's why. You probably wouldn't. You're important to the future, at least the one I come from. But if we let Niven's law take care of it, we don't know what kind of a world we'll get. It could be better than what we've got, or it could be a lot worse, but whatever it is, it's permanent. We can't go back and change it if we don't like it."

"In other words, you'd be in the position I'm in now."

"What?"

"I don't much like the future you have planned for me, but you tell me I can't change it. I have to live a life that I can't control."

"That's not so, Michael. Your real life is the only one that you do control. This is the one that you can't change, because it doesn't really exist. Sooner or later, no matter what we do, this whole sequence is going to be edited out, so nothing that happens now can possibly make any difference. There's no way we can control reality from here."

I tried to see it her way. I don't think I succeeded, but I did at least calm down a little. After a bit I even smiled. "So what do we do to kill the time?" I asked.

Kristina grinned mischievously. "Even if it never happened, we might as well enjoy it while it lasts, right?"

It was a strange bunch of thoughts that chased around in my head at two

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o'clock that morning. Kristina had fallen asleep hours ago, evidently untroubled by the paradox that kept us alive, but the knowledge that we might cease to exist at any moment kept me wide awake. I was trying to convince myself that we wouldn't die when the time patrol edited us out of reality, but I was doing a poor job. I couldn't make myself believe it. I couldn't imagine what it would feel like when they yanked the universe out from under us, but when it was over the people we were now would be gone, and gone is dead.

But what is reality? I kept coming back to that tired conundrum. College kids love to pass it back and forth for a joke, but now I was trying in earnest to answer it. If the galactic patrol (no, time patrol, I told myself. It's all so unreal!)—if the time patrol didn't change it, this life would be the real one and not the other.

So somehow I had to make sure that the patrol didn't change it.

Why? Why did I want to give up a life in which I was the famous poet I'd always dreamed of being? The future, that's why! If only half of what Kristina had described was true I still would have wanted to live there. It sounded like Eden without snakes. Fusion power, world government, longevity, space colonies, television programs that made sense—the whole utopian future. Oh, they still had problems, but they treated them as challenges, not crises. And according to Kristina I was partially responsible. So why couldn't I enjoy what I had helped create?

I had another reason to want to skip out of the life they had planned for me. I didn't want anybody programming my life. Oh, I would have free will enough, as long as nobody influenced my choices, but I would always have an audience watching me make them. Writing *The Life of Waggoner*, for Christ's sake. I couldn't believe it. It would be worse than being Samuel Johnson, having an army of Boswells following me around and jotting down notes at my every move. And every time I bumped into one of them, the reality police would be there to prop me back up again, wind the key and set me going until I hit somebody else.

I wondered if Johnson had ever wanted to tell Boswell to get an honest job. But then what would Boswell have been qualified to do after spending his whole life studying Johnson? I wondered what my future biographer would be good for, besides sending grad students back in time to spy on me. What was his name? Hohenzen? I didn't like him already. He was riding my coattails to glory, and I'd be damned if I'd let him, if I had any say in the matter. Let him earn his own way.

But I had worse problems to think about right now, namely how to keep the time patrol from discovering that something was wrong. Despite Kristina's assurances, they hadn't caught on yet. Why not?

I didn't know. She had been so sure they would—sure enough to crawl into the sack with me, knowing that they would eventually bail her out. That didn't augur well either, come to think of it. Kristina was counting on the time patrol to rescue her morals from temptation. She wouldn't like my trying to make this real.

Tough. Actions always have conse-

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quences. People had been living with it for years; she could too.

But I still didn't know if I could make it real or not. The only bit of hope I had so far was that the time patrol hadn't done anything. There could be a lot of reasons for that, but it could mean that I had already succeeded. If I had, I wondered if I would come back to tell myself how I did it.

What would it be like to meet myself, I wondered? Could I just walk up to myself and say, "Hi, Mike, how've you been?" Or would I freak out, run, scream—wait a minute! I sat straight up in bed and smacked my forehead with the palm of my hand. I already *had* met myself, in the lobby of the classroom building. Crashed into myself, to be exact.

But had that really been me? I had convinced myself then that it wasn't, but it could have been. Whoever it was had been heading into the building, possibly to pick up where I had left off. If Kristina took me back to yesterday and I slipped back in at the proper time, then it would be me.

That was hardly a solution, though. It would leave today intact, but I'd still have to act out the rest of my life and that was what I was trying to avoid in the first place. I needed a way to be in two places at once, continuously, not just loop around.

Go forward with Kristina and have a clone made? Hmmm. That was a possibility. Could that have been who I'd run into? I didn't think so. A clone probably wouldn't want to do it either. He would have his own free will. I needed somebody who would *want* to take my place, somebody who would want to follow my script. He would have to write my poetry, marry my wife, finish my English degree—everything. He would even have to read *The Life of Johnson*. Nobody was that crazy.

But I was convinced that that was the answer, if only I could find the person. I needed someone who would want to study my life right down to the finest detail and make it theirs, somebody who would be willing to spend ninety years *being* me. They would have to have plastic surgery and maybe even rejuvenation treatments, if there was such a thing. I tried to imagine what kind of person would do that.

I lay there in the dark thinking it through. When the answer came I woke Kristina with my laughter.

"What's funny?" she asked sleepily.

"I need a ride to the future," I told her. "I have to talk to Hohenzen. And then—can I get you to take me back to, oh, somewhere around 1725?"

"1725? Why?"

"I have to talk with Samuel Johnson. And Boswell too, for that matter. We'll have to go to 1790 or so for him. But if Hohenzen and Boswell are willing, and if Johnson feels the same way I do, I think he and I might take a little vacation, say for the rest of our lives." ■

● Just because we're not currently using a technology doesn't mean it doesn't work anymore.

Kelvin Throop, III

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the reference library

By Tom Easton

Raphael, R. A. MacAvoy. Bantam, $2.75. 240 pp.
The Golden People, Fred Saberhagen, Baen Books, $?. 270 pp.
Heechee Rendezvous, Frederik Pohl. Dell Rey/Ballantine, $14.95. 320 pp.
West of Eden, Harry Harrison. Bantam, $15.95 (hardcover). 464 pp.
The Shattered World, Michael Reaves, Timescape (Pocket), $6.95, 351 pp.
The Unicorn Trade, Poul and Karen Anderson, TOR, $2.95, 284 pp.
The Ghost Light, Fritz Leiber, Berkley, $7.95, 368 pp.
Universe 14, Terry Carr, Doubleday, $11.95, 192 pp.

Trilogies are practically a cliché of modern popular literature. Many critics complain that their main purpose is to milk the market, to siphon more bucks from the pockets of those many readers who wish a good story would never end.

Maybe so. Certainly many series seem very tenuously justified. Many as certainly would be much improved by compression into a single novel. Very few really seem to warrant three (or more) volumes. However, those few do exist, and one of the best current examples is R. A. MacAvoy's *Damiano* trilogy. Its third volume, **Raphael,** is now out, and it amply fulfills the promise I drew from *Damiano's Lute*, that it should tell the tale of an angel becoming human. Yet Damiano is not absent from the story. He is dead, but he does, as a ghost, return to watch over his one-time guardian angel, Raphael. And Raphael needs a caretaker. His concern for things human has weakened him, and his brother, Satan, can strip him of his wings and sell him, as a mere human, into the slavery of Moorish Spain. The shock is understandably great, and MacAvoy beautifully echoes and surpasses countless tales of humans thrown among aliens to relearn speech and custom.

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Raphael's rescue comes at the hands of Gaspare, the gamin cad who had been Damiano's sidekick and now aspires with Pope Innocent's lute to memorialize his master, and Saara, the Finnish witch who had been Damiano's lover. Together, they invade Satan's sanctum to learn where Raphael suffers. In the process, they rescue a dragon who may or may not, centuries later, become the star of *Tea with the Black Dragon*.

All ends more than well enough. The angel finds that love is no weakening influence. The devil is vanquished. The skies ring with hosannahs, sung even by the delighted reader, and the music, says MacAvoy once more, is all.

Bantam calls this MacAvoy's "best novel yet." That may be so, though no one should fail to read the whole trilogy. And everyone should look forward with bated breath to her next.

Fred Saberhagen can usually do much better than he has done with **The Golden People,** one of the first of the new Baen Books, distributed by Simon & Schuster Mass Merchandise Sales Company. In *GP*'s future, many children are reared in creche-like settings. There hero Adam Mann meets Ray Kedro, one of a hundred children genetically engineered by Emiliano Nowell, rich and independent medical researcher. Ray and his "siblings" have psychic talents, high intelligence, and—soon—Adam for a friend. They grow up together, parting as their paths diverge. Adam becomes a planeteer, a scout of new worlds, and when his service finds a strange planet surrounded by a shield that stops radar and keeps mechanisms from functioning except in a small zone, he settles there, among primitive human-like natives, human-faced, malicious beasts called geryons, and—somewhere—the builders of the shield.

Eventually, Ray Kedro and his 99 siblings, including Adam's now-married one-time love, arrive. Bent on conquest, they intend to unveil the shield-builders and master their tricks. However, they are not all agreed on Ray's ambitions, and there are penalties to the use of psychic power to do harm. These penalties may even explain the geryons.

The world of the story is Golden, named for the first planeteer to meet disaster there. The book's title thus refers to Kedro and his fellows, to the natives, to the settlers, to the shield-builders, and perhaps even to the geryons. Saberhagen never really says, but he doesn't have to. The ambiguity is a fruitful one, even though it is not quite fruitful enough. Saberhagen could have done much more with this idea, for it cries out for less pedestrian linearity and more poetic flashings back and forth, parallelisms, and philosophizings. Such things pall too easily in many stories, but I think they would have worked well here. Certainly, they might have helped to bring characters and world alive.

A far better model of what science fiction should be—and is at its best—is almost anything by Frederik Pohl. For instance, I hold up for your edification two jars of bottled wonder distilled from a lifetime as a professional speculator and fabulist: *Gateway* and *Beyond the Blue Event Horizon*. And here's a third: **Heechee Rendezvous.**

In *Rendezvous*, Robinette Broadhead is an aging man. He has the wealth he gained piloting to discovery the ships left behind by the vanished Heechee, and he invests it in enterprises designed to improve the human species' likelihood of survival. He has for company a Russian wife, who runs an arch-emblemed fast-food empire that peddles synthetic food made from Heechee recipes, and an artificial intelligence mo-

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deled on Albert Einstein. The flies in the ointment are terrorists who use Heechee equipment to broadcast nightmares to all of Earth, a mad youngster who flits about using stolen Heechee equipment to probe black holes looking for his lost father, and the ravening Assassins whom the Heechee themselves fled eons ago.

Broadhead's efforts eventually lead to the capture of the terrorists. The mad youngster recovers Broadhead's long-lost love, Gelle-Klara Moynlin, from the black hole Broadhead had once escaped alone. The Heechee erupt from their hideaway to tell the humans to SHUT UP! before they attract the Assassins' attention. And so on, to great and marvelous effect.

One of the nicer touches in *Rendezvous* is what happens to Broadhead himself and the viewpoint from which he must tell the story. Heechee technology has led to vast improvements in data storage and information-handling technology. One result is the Here After firm, which can record a personality before—or soon after—death, install it in a computer where it enjoys a pseudolife, and make it available to the heirs after death. This is akin to a Heechee practice, for they store all their dead this way. It is also the key to Broadhead's "vastening," to which he cryptically refers throughout the book, and eventually explains. I can't help but think that "vastening," which promises vast extensions of life and awareness, must appeal to anyone who, while still full of energy and curiosity and creativity, must confront the limits of human life. It appeals to me, and I by no means share all Pohl's years.

There are other nice touches as well, including Pohl's parting thought, but I won't describe them. It is enough to say that *Heechee Rendezvous* largely fulfills the promise of its two predecessors. Read it, and wonder with me whether Pohl has left himself room for still another sequel.

Harry Harrison's latest opus is a massive and admirable attempt to transform evolutionary biology and catastrophism into science fiction. Considered by itself, the fiction is very nice indeed. The science, however, is another matter, for though Harrison credits several experts with helping him, he blew it.

In **West of Eden,** Harrison supposes that the asteriod or comet that 70 million years ago wiped out the dinosaurs (among others) and gave the mammals their chance never arrived. The dinosaurs were left free to continue evolving, eventually giving rise to the Yilanè, a very interesting species whose biology affects their psychology and culture quite reasonably. Over reptilianly slow eons, they have developed a technology of biological engineering to produce countless specialized creatures, from boats to cameras. They have also covered the warm portions of the continents of Africa, Asia, and Europe. When the climate cools, they seek new warm lands and discover the Americas. However, the Americas already hold humans, and when the two species meet, their antipathy is deep and mutual. The Yilanè slaughter a tribe, capture and enslave the child Kerrick, and mount a war of extermination on the humans. Kerrick learns language and culture and eventually escapes to lead the human war against the Yilanè. Harrison portrays his Yilanè characters and Kerrick very well, and the reader has little trouble empathizing, even as he yearns to kick them for their blind idiocies. Harrison gives us a cracking good yarn in which humans stand for an idealized tribal life and the Yilanè stand for vil-

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lainized urbanites. He trades vigorously on the myth of the noble savage, and he stirs within us all the classic sentiments of the adventure yarn.

But he still blew it. For one thing, he makes his dinosaur-types cold-blooded, despite the case for hot-blooded dinosaurs. He tells us that the site of the meteor impact in our world is Iceland, which is the wildest of guesses (it may be right, but who knows?). He has humans evolving in the American north, even though the evolutionary line that led to humans required the African tropics for its appearance. Further, he tells us that his humans descend from New World primates, since the Old World pimates don't exist (their place in biological history having been preempted by the dinosaurs). However, the New World primates are themselves descended from the Old World stock, having split away some 35 million years ago when continental drift separated the Americas from Africa.

There are more gaffes too, in biology, climatology, anthropology, and so on. Some of the problems seem due to simple haste. Others may actually be deliberate inconsistencies forced into play to make the story work. Harrison's humans may be one such, for the only way to escape the difficulty with them would be to posit a very different mammalian intelligence or to suppose that the whole story happens on another world, where human colonists meet saurian aliens. In either case, the result would have been a very different story, and Harrison would have been unable to evoke the richness of double vision.

If you could care less about biological or scientific plausibility, you will enjoy *West of Eden* greatly. If you do care, you will be endlessly irritated. Either way, you have to applaud Harrison's ambition. His conception is grand, if flawed, and he executes it very well.

Michael Reaves's **The Shattered World** is another grand conception, easily three times as unlikely as Harrison's but saved because Reaves calls it fantasy. Centuries before the story, the Necromancer, in a snit because the world would not bow down to him as its ruler, smashed the planet into fragments. Other wizards did the best they could to save the situation, equipping each fragment with a Runestone to supply gravity and to keep it orbiting not too far from all the rest. Travel from fragment to fragment is by sky-sailing ships built of dragon bone and skin and fitted with their own Runestones (they use sails and rudders, but Reaves nods to the impossibility of control by muttering something about playing different wind currents against each other).

Now, however, the orbits are decaying, and a league of wizards is trying to rediscover the Necromancer's secrets in order to rebuild the world. Other wizards believe nothing but evil can come from exploiting the power of the dead. The first group sends the werebear thief Beorn to steal a Runestone from the chief among the second. And the chase is on, to grand and glorious effect, through flying castles and the caverns of Hell (exposed, of course, when the Earth shattered), through waterspouts and boudoirs and tombs. The thief and his victim find varieties of love and satisfaction. The Necromancer turns out to be other than his reputation. And the shattering of the world emerges closer to Harrison's dreams than to, say, Vance's.

The Unicorn Trade is a delightful collection of stories and poems by Poul and Karen Anderson, some by both, some by husband, some by wife. Karen

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seems to have the lighter touch, as in the title poem, and to be more purely a fantast. Poul is both fantast and scientifictioneer. When they get together on a story, as in "The Innocent Arrival" and its discovery of a highly profitable Martian export, the result is vintage wry, good-humored projection of a possible future. Or it may be "The Kitten" whose wryness is that of horror. Whatever, the book's entries are each a pleasure to read.

Fritz Leiber's **The Ghost Light** is the second in the Byron Preiss Masterworks series. It also shows a master's mind at work in the long autobiographical essay ending on the note that leads into the title novella, appearing for the first time here. The novella's stimulus is a gift nightlight with green and blue panes; it prompts Leiber to wonder if the right kind of nightlight might not attract rather than keep away the things that go bump in the night. And so the story—a strange, reformed-alcoholic recluse, the relics of a past tenant and artist, a painting of a dead wife and mother, visiting son and daughter-in-law and grandson, strange fancies, and a California mudstorm add up to a masterwork of mood and tempo and horror.

The book's other stories are all well known. They include the memorable "Coming Attraction," "A Deskful of Girls," the famous Gummitch of "Space-Time for Springers," "Four Ghosts in Hamlet," "Gonna Roll the Bones," "Bazaar of the Bizarre," "Midnight by the Morphy Watch," and "Black Glass."

The autobiographical essay, "Not So Much Disorder and Not So Early Sex," is a rambling but thorough account, tied to the stories here but unsatisfyingly incomplete. Leiber is reluctant to repeat himself too often, and he tells us that some aspects of his life he has discussed quite adequately elsewhere. We thus hear little of his alcoholism, for instance. Leiber husbands his energies for original work, not for pointless rehashings. We could wish he felt otherwise, but the rest of the tale *is* available, and I have mentioned the pieces of it that have come my way in past columns.

What with the Ace Specials and the Best of the Year and Universe anthologies, Terry Carr must be a very busy fellow. He seems to manage, though, and we can be happy he does. **Universe 14** is now out, and it is, as usual, a most excellent assortment of stories. The only exception is Damon Knight's excessively cute "O," in whuse shurt cumpass we see the effect uv dewing away with wun letter uv the alphabet, as well as all places, things, and peeple whuse names begin with that letter. The effect is audly Irish. (I seem to recall that Knight did a similar number on the letter *a* not so long ago; whr wll t ll nd?)

The book also contains Lucius Shepard's excellent "Black Coral," in which an ugly American is put in his feebleminded place by the spirits of a Caribbean isle; it seems familiar, as if it has appeared elsewhere, but I can't place it. Greg Benford's "Me/Days" tries to capture a sense of an intelligent computer's consciousness. Joel Richards's "Dead Time" considers how someone might try on crime when time travel makes it possible to undo disaster. Pat Murphy's "Art in the War Zone" shows us an unsuccessful attempt by artists to make war as art. Sharon Farber's "Passing as a Flower in the City of the Dead" considers that if people with rebellious immune systems have their immune systems wiped out and are transplanted to a sterile satellite, they will show other kinds of rejection. ■

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Joseph H. Delaney

THE SHAMAN

Supermen get little peace—they're too useful to the rest of us.

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Kim had been closest to the house when the faint slap of skimmer fans had attracted her attention. She knew that Casey must have heard them too, and that he would now be heading home, but it would take him longer to get to the house. He was on the far side of the lake.

Without hesitation she called to her children, who were out in the brambles picking berries. They came, Kevin first, followed by his sister, Angela. Neither of them had seen the skimmer, though they had also heard its sound.

Kim could not imagine who the visitor might be. They lived far out in the hinterland, away from any close neighbors, on a world where men were still scarce and skimmers even rarer.

She herded the children together and told them to stay in the woods while she approached the house. They did not understand, having been raised here on Ithaca, and never having seen a stranger.

But Kim knew this was not one of their neighbors. None of the neighbors had a skimmer. When one called, which was rarely, he came on horseback or in a wagon pulled by an electric tractor. This visitor must therefore be from the city, seven hundred kilometers away. Kim did not find that thought comforting.

Leaving the children at the edge of the glade she circled around to the back of the cabin, hoping to be able to enter through the back door and find a robe before confronting whoever it was. Ithaca's warm climate, and their isolation, did not demand a great deal of clothing. She, like the children, wore the minimum.

Too late, she realized that her visitor had grown impatient and wandered away from his skimmer. He was approaching the back door from the opposite direction. And Kim knew him. At the sight of him, she broke out in a cold sweat.

"Kim! I must say, you're looking good. Colonial life seems to agree with you."

Abashed at her near nudity in the presence of this imposing man, Kim stopped, folded her arms across her chest, and stared. "Mr. Carmody! W-what are you doing here?"

"I came to see Casey, Kim."

"What made you think Casey'd be here? I haven't seen him in years."

Carmody sidestepped the question. "Aren't you going to invite me in?"

Kim did not answer immediately, so great was the shock at seeing him here on their world. It was like meeting a ghost out of the past. Her mind raced. Undoubtedly Carmody had penetrated the maze of false trails Casey had laid, and probably he had tracked her own as well. She had been the weak link, and it would not have taken any great ingenuity for someone with Carmody's resources to deduce that the "Kevin C. O'Meara" she had married on Wolfingham was in fact, Kah-Si-Omah.

Proving it, however, was another matter entirely—thanks to Casey's many years of holding steadfastly the O'Meara persona. Physically, he was completely unlike his former one, even to fingerprints, retinal patterns and voice print. Kim decided to continue the bluff.

"Of course, Mr. Carmody. You must have had a long, tiring trip. Follow me."

She led him into the cabin's one large

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ground-floor room, seating him in one of the rough-hewn chairs that surrounded the kitchen table. From a pot on the stove, she poured a cup of steaming liquid. "It's not quite coffee, Mr. Carmody, but it's good. There's something like caffeine in it. We call it mescof." She did not think it either wise or necessary to tell him it was also mildy hallucinogenic. If he drank only one cup he would barely notice.

"Where *is* 'Mr. O'Meara,' Kim?"

"Somewhere on the lake, Mr. Carmody. He went fishing. It may be quite a while before he gets back. Excuse me; my kids are outside. I have to find them."

Carmody did not show any curiosity about that, and Kim ducked out the back door into the wood where the prepubescent Angela was busy stuffing her mouth with berries, at the same time fighting off her brother, who wanted some too. "Stop that fighting, and listen to me. Find your father and tell him Mr. Carmody's here. Got that, Ivan Carmody. Then stay with him."

Neither child understood what was happening, but they could assess the tone in their mother's voice. It was a signal that something unusual, perhaps terrible, was happening.

Kim picked up what was left of the basket of berries and re-entered the house through the front door, stopping briefly to snatch a robe from a peg on the wall. Returning to the kitchen area, she poured herself half a cup of the brew and sat down at the table across from Carmody.

"Uh—Well, Mr. Carmody; what's happening in the rest of the universe?"

Carmody took a sip, made a face, and pushed his glasses back up on the bridge of his great hooked nose. The piercing blue eyes stared out, having lost none of their power to intimidate Kim. "The universe of man may be in danger, Kim. Why else would I travel eighty-eight parsecs to ask for Casey's help?"

Noting the look of confusion on her face, he explained. "I'm not in the Ecological Service anymore. I'm Commissioner of Alien Affairs now; quite an important office these days, if I do say so myself. Sort of a promotion. You *must* have been out of contact for a while."

"Fourteen years. And I'm afraid I haven't paid much attention to the news lately. We rarely hear any. Half the time I don't even bother to listen to the local stuff."

"You wouldn't have heard about this on a broadcast, Kim. None of it's been made public; we're handling it on a 'need to know' basis. Actually there may be nothing to worry about. But on the other hand, the human race could be headed toward real trouble."

"Because of what happened on Campbell?"

Carmody nodded.

There was a slight creaking sound; very faint, and audible only to someone who was listening for it. Kim was, Carmody wasn't. And the timing was perfect.

"It's a long story, Kim. Things have happened since you left there. By the way, I never repeated what you told me." He looked at her as though he expected to find her grateful for that.

"So, you see, my decision to come here was really a very personal one."

"I don't understand what you mean."

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"It's my way of demonstrating to you, and to Casey, that I can be trusted; that I haven't, and won't, compromise his secret. Kim, do you remember what you told me about him; how he was altered by extraterrestrial visitors back in prehistory, and how he's lived ever since, wondering what his destiny might be?"

"It sounds melodramatic, the way you put it, but yes, of course I remember."

"This may be it, Kim. Things haven't worked out quite as we expected."

"Oh?"

"No. When this thing broke, the government was convinced the alien prisoners in that concentration camp on Campbell could help us make a quantum jump up to their level of technology. And that theory was partly Casey's, if you recall."

"Yes, well, he did open communication with them."

"Uh-huh. And then he disappeared. I guess he figured the job was done."

"As far as he was concerned, it was. Look, Mr. Carmody, Casey's lived a thousand normal lifetimes. Surely his wisdom's vastly superior to anyone else's."

"Perhaps; if he's kept informed. But when he disappeared he left the task to mortal men, and we can't handle it. The problem is that almost all the prisoners who come out of that mattercaster on Campbell were political dissidents. They knew a great deal about their own social systems but very little about anything else. So they can't do for us what Casey thought they could. At least, that bunch can't."

" 'That bunch'?"

"Yes. What you saw on Campbell was only part of the penal system. There's more to it.

"You see, the two races we've grown accustomed to calling the Satyrs and the Skinnies are part of an actual interstellar empire. Yes, I know that we always considered such things impossible, but that's before we knew about matter transmission; an empire dependent on spaceships for transport could never hold itself together.

"They accomplished this largely by accident, because they each discovered the principles independently, and each had a fairly extensive network of stations by the time they met.

"When they met, the Satyrs got caught with their pants down. They've been the junior partner in this empire ever since, and the skinnies dominate them almost completely. Together, they dominate half a dozen lesser races who are inferior to them in technological achievements. If we aren't careful, humanity could find itself in that category."

"But they don't know we exist."

"True. But we know they're expanding in every direction, including ours. They went to the trouble to put that station on Campbell."

"That's something that's always puzzled me."

"They had political reasons. Doing it that way saved them the stigma of executing dissidents and making martyrs of them. What they've done, in effect, is say to the dissidents, 'here's an empty planet you can have, together with all its resources. Make something of *it*.' A shrewd move, I'd say.

"But they are capable of getting

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tough on other kinds of dissidents, and some of their more stubborn scientists. These are the people who interest us."

"Where are they?"

"On their own prison planet. It's organized a little differently from Campbell, but physically it's not very far away. That, by the way, is illustrative of the problem."

Kim did not comment. She continued to listen.

"The idea is to keep the scientists productive, though under firm control. We learned a great deal about it from the prisoners who've turned up on Campbell. We even know its location with a fair degree of certainty. Now, we need Casey's help. We have to get somebody in there, and we have to get those people out. What's more, we have to do it in such a way that their captors never know they had outside help."

"And, naturally, you want Casey to be that 'somebody'?"

"He's the only one who could possibly do it."

"I'm sorry you came so far, Mr. Carmody, and that I can't help you, but I haven't laid eyes on Kah-Si-Omah for over fourteen years."

"You don't lie very well, Kim. I suspect you're using a little crutch, too. I'd venture to say the 'new' Casey bears no physical resemblance to the 'old.'

"But I can understand your feelings. It would be dangerous, even to him. And the reason why nobody else could do it is that a normal person, either a human being or one of the prisoners, would have the same vulnerability to that peculiar planet as the scientists do.

"You see, something about the prison planet is poisonous to the people who are imprisoned there."

"I don't understand. How can that be, when you just said they keep the scientists productive?"

"The way it was explained to me, the poison is relatively slow acting, and there's an antidote. If the antidote's available the damage can be reversed. The poison's called a—" he dug into a shirt pocket and pulled out a notebook, flipped through it and read—"a 'competitive inhibitor.' Does that make any sense to you?"

"Some. Do you know what happens to the person when he's exposed?"

"He becomes too weak to move. Later, he can't breathe, and then he dies."

"OK. Then I assume that whatever it is interferes with the utilization of muscle glycogen—or whatever these creatures use to power their muscles."

Carmody consulted his notebook again. "Yes; that's the word. In that respect both the Satyrs and the Skinnies are pretty much like us."

"That follows. When we were on Campbell they ate the same things we ate, and survived. But how come you know all this?"

"There were some escapes, a long time ago, when the place was being set up. The dissidents got wind of them, and helped them. But things have changed, and nobody's gotten away lately. The dissidents have made a couple of attempts to raid the place, so far without success. The planetary system is heavily patrolled. A ship can't get near it."

"Then how could you expect Casey to do any better?"

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"I don't know that he can, but he's the only one who has a chance at all. The dissidents think they know how to get him in. Of course, there's still the problem of getting him out, together with all those scientists, and . . ."

"It sounds suicidal, Mr. Carmody."

"So's the alternative. Look, Kim; these are people who *do* know something about that technology we need. As a matter of fact, some of them are on the cutting edge of it. They're imprisoned because they're balky, and because they're in sympathy with the dissidents, which means they might be grateful enough for our help to get us into the club. If we *don't* help them we'll just have to sit here basking in our *ignorance until we're discovered and* gobbled up. And, as I said, we may not have much time."

Kim looked over at him and did not know how to reply. She knew he knew Casey was here on Ithaca with her. She was fairly positive Carmody was telling the truth, both about his own silence and the gravity of the emergency. But, she also knew that concealed in the room, out of Carmody's sight, Casey had listened to every word. And Casey had maintained his silence; he was not ready to make a judgment.

She took this to mean he wanted more information, and there was only one way he could get it: from Carmody, through her own questions.

"OK, Mr. Carmody, suppose Casey were willing. What would the plan be?"

Carmody glanced around, almost as though he sensed he was being tested. Apparently he saw nothing obvious. "We don't know what the antidote is. If we did, it might be worthwhile to try shooting it out with the prison defense people. Since we don't, and since the prisoners are scattered around all over the planet's surface, it's doubtful if we could hold them off long enough to get everybody out. That's one reason for not trying it. The other, of course, is that they'd know about us, and if we couldn't shut them off from reinforcements they'd cream us anyway.

"So, what we have to do is get Casey down there. If what you've told me about him is accurate, he could not only assume the physical form of either a Skinny or a Satyr, but he could neutralize the poison his body took in. We know they have to have a supply of the antidote available."

"*That's all he has to do? Go in*, get the antidote, collect the prisoners and get all of them out again?"

"Uh—well, that's an oversimplification. Actually, there's something else I haven't mentioned yet: the guards have a distribution system already."

"I see. Well then, why don't the scientists just take over the place themselves?"

"It's a very ingenious system. It works this way. Each prisoner, or in some cases, two or three prisoners —never more than that—is isolated in some region where he couldn't possibly walk to the main transmitter. That's even assuming he knew how to get there. Each 'cell' has its own one-way mattercaster terminal. The terminal supplies food, water, if necessary, and . . . antidote. But there's a diabolical catch to it. To get any of this the prisoner has to work. Each transmitter has a crank on it. Every day the prisoner has to turn the crank until his supplies

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come out. He gets just enough antidote to keep him going one day, until the next cranking period. Naturally, all this exertion increases his vulnerability to the poison.

"In the case of scientists, they apparently allow a substitution of scientific for physical work, but even there the prisoner gets only what's necessary to sustain normal muscle activity. He can't stockpile any so that he can go see his neighbors.

"What we hope Casey might be able to do is get into the main control area, find some way to organize the prisoners into a revolt, and give them enough resources to carry it out."

"He's *not* a superman, Mr. Carmody."

"Oh, yes, Kim; he is. Compared to you or me, or any other being I'm familiar with, he is just that: a superman. And a superman has obligations, Kim, because of his stature. That's his purpose in *being* what he is."

"No. Casey didn't ask to be anything special, just to be a man. That's all he ever wanted out of life."

For a moment, there was silence. Then a third voice rang out. "He's right, Kim." From the shadows a figure emerged, stepped forward into the light.

Carmody had turned. He studied the features of the man. "Casey?"

And then he realized abruptly that he had never seen the man before, only his photograph. This man did not resemble that photograph in the slightest.

"I am here, Mr. Carmody. I have heard your words. I agree."

"Casey! No!"

"The man is right, Kim. It was wrong of me to ignore the problem and walk away. I should not have done it."

"But it's not just 'your' problem, Casey. It's everybody's, and it's not fair that you should be . . ."

"No one else can, Kim. You must remember what I did on Campbell. I became one of *them*, and with that physical metamorphosis came some understanding of their culture. They are different from us in many ways, but they have basic drives that any race of survivors must have, just as we do. We are dangerous to one another."

"And at the moment," Carmody remarked, "the contest is lop-sided. They have the transmatter devices and we don't. Don't you see, Kim. If the contact were made today, human culture would simply be overwhelmed. Do you want that to happen? Think of your children if you don't care about yourself."

Kim was not convinced. Perhaps she would never be convinced. But in the end, she was resigned.

Casey joined Carmody at the table, where they talked at length in quiet tones which Kim preferred not to hear. She left, rounded up the children and went back to the berry picking.

When she returned an hour later, they were still talking. She began preparing dinner, assuming Carmody would stay the night.

That he did, though as far as she could tell neither he nor Casey had slept. Morning found the two of them still at the table, which was now covered with dozens of thick, plastic bound reports —statements of the observations of prisoners interviewed by the Department of Alien Affairs, and of human experts who had interpreted these.

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When Kim appeared she was aloof. She knew what Casey was going to say and didn't want to hear it. But she also knew that any efforts to dissuade him would be useless.

After breakfast Carmody went on a sightseeing trip with the children—undoubtedly at Casey's suggestion, in order to give the two of them a chance to talk. It was largely a one-sided conversation. Casey talked, and Kim sulked.

"It is even worse than he said, Kim. We are surrounded by alien colonies. It is only because of extreme good fortune and the vastness of space that contact has been delayed this long. It cannot last; it could happen at any moment."

"And if they catch you, Casey? What will that do? Make it better or make it worse?"

"They will not catch a human being, Kim. They will never know that it's what I am. Besides, as you will recall, catching me is one thing; holding onto me is quite another."

He was right about that. His ability to alter his form rapidly, to assume the features and appearance of almost any individual he chose had saved her life during the ordeal on Campbell, and had given them fourteen years of peaceful anonymity.

"What about me—and the kids? How will we manage in the meantime?"

"I will not be away that long. Mr. Carmody has agreed to care for you while I am absent; he will arrange for people to watch over you until I return. Of course, you could always go into the city . . ."

"No, Casey. Here we are, here we stay. We will wait for you—here."

In his time Casey had said many goodbyes to many people, among them many other wives and many children, of course. That had never mattered before and it did not matter now. Goodbyes were always painful, particularly under these circumstances. He would come back, of course. He always had; he could be certain of that. But he could not be certain that when he returned, the ones he had left behind would not be dust. That had happened on occasion, when he had been delayed; and a being such as he who existed, for all practical purposes, outside the bounds of time, must exercise great care in his relationships with those who didn't.

The ship was a cosmetic copy of a Satyr scout. One of the crewmen was the same. Humanity had been hard-pressed to cobble it together from the fragmented descriptions supplied by the prisoners, few of whom had ever seen one of their own interstellar vehicles.

But there had been a few, and from those few they gained enough detailed information to make it superficially like the real thing. They had not been able to avoid the Aschenbrenner engines, though; and that had caused delays because of the need to train the aliens in their use.

The six-member crew, chosen entirely from prisoners unaware of human existence, did not know who Kah-Si-Omah really was. He professed to have come from a remote Satyr colony, and they were satisfied that this was the explanation for his faint accent and somewhat different behavior.

Neither did they know the purpose of their mission. That information was reserved for the planners, both human and

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satyr, who rested easier in the knowledge that what the crew did not know they could not tell.

On the surface of things, the operation really made no sense. They were to travel to a nearby colonial world, make a planetfall in the hinterland, and await further instructions.

The satyr personality was such that none of them found this unreasonable. They had, Casey observed, relatively little personal initiative, which perhaps explained why the highly individualistic skinnies were able to dominate them so completely though their culture was markedly younger. But the satyrs excelled at teamwork. They could take an idea and execute it with faultless precision. That was the reason they made up the mass of the military forces of the empire, and why they had been chosen to crew this ship instead of the skinnies. Satyrs could be depended upon to listen to explanations and to follow instructions without deviating.

The voyage took 210 days. The last day found their ship coasting along on reaction drive just outside the orbit of the fifth planet of a rather anemic looking sun. Their destination within the system was the fourth planet, an earth-sized body with slightly more than half its surface under water.

Most of the colonization had taken place on an archipelago, offshore of the largest continent in its southern hemisphere. Movement into the continental interior had not yet gotten much of a start, which was the main reason it was selected. The population was predominantly skinny, and the rest satyr, together with small numbers of three or four other subject races. Whatever else might be said of the empire, it did not seem to play racial favorites.

After a period of intense observation the crew was satisfied that there were no spatial defenses. They moved in and made a fractional orbit polar injection, which brought them down about fifteen hundred kilometers from the coast.

The land was high desert, containing no large vegetable forms. It was windy and sandscoured and thoroughly unpleasant. It would be, Casey thought, a bad place to be marooned—yet that *had to happen*. He made certain that it would. Once the rest of them had carried out their instructions and established camp a sufficient distance from the ship, he set the timer which destroyed the ship fifteen minutes later.

Then, gathering about him his little cache of supplies, Casey headed for the sea. Alone and unencumbered by any followers, he would make it in twenty days.

The imperial prison on Maygarth was a masterpiece of skinny planning: perched atop a mesa with unclimbable walls, set in the middle of a desert no creature on foot could hope to cross.

New prisoners came in over the transmatter. The transmatter crew was rotated the same way. Only a few of them ever went out onto the surface, preferring to avoid the poisonous agents there and stay inside the sterile dome.

Those who went out did so protected by airtight suits, and only for the purpose of conveying prisoners to their own places of captivity. This was done in a skimmer-like device whose controls were keyed to its pilot's retinal patterns. Once delivered, a prisoner never left and

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was never again visited by a guard skimmer. Whatever he needed was supplied to him from a remote terminal. If he died his 'cell' was reused, after a suitable interval.

So, the guards were quite well insulated from those in their charge, and so confident they would never have an escape attempt that no arms were kept in their dome. The theory was that if the impossible happened there would be ample time to secure weapons by means of the transmitter.

Burnollus, an old skinny, sick already when he had come here, suffering from degenerating hearts and leaking valves, strained as hard as he could. Yet the accursed crank he labored to move had turned only a fraction of a revolution, and the counter to which it was attached had not clicked off the credit.

The old creature did not know where he would find the strength to try again. Already his breathing had become labored, not only from the effects of the poison which was progressively inhibiting his muscular efficiency, but from the inability to maintain rigidity. Lacking bones, his form was maintained by hydraulic pressure, which even before imprisonment had been low.

If he could not turn the crank the required number of revolutions and get the antidote, death was certain. He had known, as every creature does, that this end was inevitable; yet, in spite of his circumstances and his utter lack of hope that these would change, he could not simply give up.

Burnollus was a scholar and academe of the Imperial University. He was not a quitter. Had he been, he would still have been there, living in comfort and enjoying the prestige of his station. But he would also be pandering to the base motives of the Imperium, and building weapons the Imperium could use to enslave or destroy more cultures than they already had.

Perhaps, had he possessed more political acumen, or more tact, he would not have placed himself in a position of confrontation with the government, but at the time this had seemed unavoidable. He had been working quietly and steadily on a project that he assumed had no military application. That had been untrue. A chance discovery had opened the door; and before Burnollus himself recognized the possibility, some underling did.

He could not thereafter close that door again. He had been approached by imperial agents and ordered to continue his research, but to change the course of that research toward their goal.

He had refused, not realizing at the time that as he did so, he talked his life away. Yet even now, with death in hot pursuit, he still refused to give them what they wanted. Instead he turned the crank, grinding out each day enough to keep himself alive. He knew that his captors had calculated his needs with extreme accuracy, and that they had also been remarkably shrewd in assessing his physical abilities.

But this time, he thought, *they have overestimated me. This time, I will not be able to turn my quota*. He wondered briefly if, in hopes of getting what they believed he alone could provide, they watched over him; if, at the last possible moment, they would snatch him from the jaws of death.

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He strained again to the upright position, and grasped the crank. It was at the bottom of its stroke, the most difficult position of all. If he could just get it up to the top . . .

He couldn't. The effort drained him. He knew his laboring hearts were incapable of maintaining his skeletal pressure. Their muscles were becoming impotent too, even though his body was undoubtedly marshaling all its resources to keep vital organs going. It would not be enough.

He let go the crank; then, pressure dropping rapidly, breath shallow, he let himself fall.

Now, for a while, without the need for his body to fight gravity over such extended distances, his failing muscles would keep him alive a little longer. He could still see fuzzily, and hear, and feel, though he could no longer move his head.

How long he lay there in his paralysis he could not judge. Because he could not move his head he did not see where the stranger had come from. But there the stranger stood, looking down at him, and fishing around in a pouch he carried.

So, Burnollus thought, *I was right. They don't intend to let me die.* For a brief moment, he felt triumphant. He had compelled them to deviate, to notice him. He had interfered with their carefully laid and, until recently, completely workable plans.

And then he realized he had really accomplished very little. He had caused them to pause; that was all. He had not permanently deprived them of anything. They would be as stubborn as he was. They would rescue him, time after time, and one day he would grow tired of the pain and the misery, and abandon that course. They were merely waiting for that to happen.

Reality hit him. He had not considered self-destruction before. He had been confident the planet itself would take care of that, relieve him of the responsibility and compensate for his lack of motivation. Now, he knew, this could not be avoided. Therefore, since he could not stop them from reviving him he must take the strength they would give him and use it to end his existence.

He felt a small pain, nestled amongst a multitude of greater pains. He knew the other had injected something into his bloodstream. No doubt it was a dose of the antidote. He would know in seconds, if his strength began to return.

Gradually, the labored breathing became more regular. His hearts pumped with more force, and drove away the fuzzy halos that had begun to crowd into his visual field. As the moments passed he felt a newness to his body, more vitality than he had known since the day he arrived. He had forgotten what it was like not to hurt, not to feel tired.

He raised his head, testing the strength of his muscles. His hearts beat strongly now, and his body was rigid. Experimentally he extended an arm, using it to push against the ground. He was almost instantly in a sitting position, though he did not dare try to rise to his feet.

He turned his head from side to side, expecting to see a skimmer and a guard. He did not.

"Here," a voice called behind him.

Burnollus struggled to get his other arm behind him, and then to scoot him-

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self around. What he saw then amazed him. There was the stranger, standing stark still, within easy reach and unarmed. He wore no clothing other than the belt from which his pouch hung. He did not even have shoes. There was no sign of any vehicle. It did not seem to Burnollus that he could be a guard.

The stranger spoke again. "How do you feel?"

"Stronger. Who are you—you're not one of *them*, are you?"

"No. I am a friend. It appeared to me that you needed a friend just now."

"How did you get here?"

"I walked."

"Across that?" He pointed out toward the horizon, where nothing which did not grow here had ever been.

"Yes. I will explain later. Now, you must rest. I will turn your crank."

Burnollus allowed the stranger to help him into his little shelter. It was little more than a lean-to, designed to give minimum protection from sun and wind, and from the rare rainstorms.

He could not imagine why the stranger had come, or *how* he had come, but undeniably he was here. And his rescuer was a sensible individual, too. He knew that the crank would have to be turned or else suspicious monitors on the other end would wonder what kept him alive.

After a time the stranger returned. In his hand was an ampoule filled with anti-toxin. The stranger placed it on the shelter's lone shelf. "For later," he said. Then he slid slowly down the wall and sat on the lean-to's floor. "Now," he said, "I must rest."

Burnollus watched, but the stranger's idea of rest was more enigmatic even than his tale. At first, Burnollus believed his eyes were playing tricks on him, as subtle changes occurred in the stranger's form. First to go was pigmentation, which in Burnollus' race varied from nearly black to light gray. The stranger changed that even more drastically, becoming a weak and sickly reddish brown.

While this was going on the shape of his had changed. His face became deformed. Pressure vessels which held the cranial shape seemed to melt away, yet his head did not collapse, as it might be expected to do.

Burnollus watched, spellbound, as the same thing happened to his limbs and torso. In place of the pressure vessels, with their interlacing bundles of *muscles*, something else was holding the stranger's body rigid. That something else appeared to be an endoskeleton.

These were the norm with every race but his own, so the fact that this "creature" had one did not surprise him. But he was not aware of any life form which could alter its appearance the way this one was doing.

He did not note the passage of time. It was, however, an extended interval before the creature spoke again. Burnollus could not detect any change in the voice, though he had expected one. Drastic as the change of shape had been, this was peculiar.

"Now," said the stranger, "you see me as I really am."

"What are you?"

"I am a human being. I have shown you what you have just seen so that you will believe what I am going to tell you."

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"I have not previously heard of your race."

"That is good. Let us hope that such ignorance continues to prevail."

"Why did you come?"

"To help you escape."

"Escape? To where? You said you walked here. I cannot walk so far. I am too old and too feeble, even if I have enough of the antidote."

"The antidote is available in the necessary quantities. And you will not be alone. Others will come. As many as we can possibly take."

"But how—where would we go? There is no safety anywhere in the Imperium."

"We will go outside the Imperium, to my people, where many of you have already gone along with many of those we call 'Satyrs' which you know as the Kaii."

Burnollus did not respond. He needed to think. This "human" could be what he said he was, of course, but most probably he was not. Most probably he was an imperial spy. How else would he get his hands on all that anti-toxin? How else would he get around on this God-forsaken world? No doubt, concealed somewhere close by, he had a vehicle. Perhaps he had companions too. It could very well be an imperial scheme to persuade him to cooperate, and to avoid his self-destruction.

"Tell me more about these people."

Casey did. He started at the very beginning, with the human discovery of the other penal world of Campbell; how the races had met, and how the imperial government was as yet unaware of human existence. He went on to the subject of the government in exile which had been formed, and explained the human technological weakness.

All the while Burnollus listened, becoming less and less incredulous, until Casey told him how he had gotten to Maygarth. Then, he became a little balky. "Are you telling me that you—one creature, all alone—simply went to a colonial planet, assumed the appearance and identity of a local, and transported to the imperial capital?"

"Essentially, yes; that is what I did. When I arrived, I contacted the underground. . . ."

". . . The what?

"The dissidents. I entered the prison where they were holding people for transportation to this place, substituting myself for one of them. It was easy to get here."

"For you perhaps. But even for you, it may not be as easy to get out. How do you intend to do it?"

"I am going to rely upon you, and upon the rest of the scientists here."

"What? That is insane."

"Perhaps. But what alternatives are there? Surely the only practical means of escape is the transmatter system, and there must be many people here who understand it intimately."

"Undoubtedly there are. I am, of course, one of those, but we are scattered all over this planet. . . ."

"We will do it. We have to."

"It will not work—not with just one of you. Why did you not bring others to help? For that matter, why is it necessary to involve us at all? Why not simply infiltrate the Imperial Government and take control of it?"

"Because there are no more of *us*. I am the only one there is. Now, let us

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stop this bickering. If we *are* to leave here then you and the others must follow the plan; you must obey my orders, otherwise we have no chance at all."

"I will not follow you blindly. I do not recognize any authority in you. You cannot give me orders."

Casey turned to him. His own immortality had taught him patience, and this was a virtue he ordinarily cultivated. But he would do it just so long. "I can let you die here, then. I cannot take responsibility for your welfare without having authority over you also. You will either submit to that authority or I will leave you." Casey knew these words would carry weight. He had learned in his first contact with the aliens that "humanity" was not a matter of body form, or even a matter of culture. Humanity was a state of mind; a bundle of emotions, including fear and greed and all the rest. Every race had these, needed them, could not exist as a sentient race without them. That was a universal truth.

"But you need me; you said your race does not have modern matter transmission."

"True, and you *could* help give us that. Perhaps you could give us an even better system than the Imperials have; but you are not the only one who could do it, and I am the only one who can get you out."

That ended the prisoner's hesitation. "I will agree. Tell me what I must do."

Casey did. For the rest of Maygarth's day he instructed, while Burnollus made careful notes. When darkness approached he walked away, in the direction of the setting sun, toward his next contact.

He would not visit every prisoner in the weeks to come; just the ones his discussion with Burnollus indicated would be essential to the escape plan, or who must be given special incentive to stay alive until that plan could be executed. Sometimes he would appear as a skinny; at other times he was a satyr. Rarely did he use human form; rarer still were there witnesses to the transformation. But always, he would preach secrecy, perseverence and resolve, and always he left with a promise of obedience in return for his help.

Throughout it all, one thing bothered Casey more even than the prospect of his mission's failure; that was the danger that in the interim humanity would be discovered by the Imperials. That fear drove him mercilessly, and he hurried the project along as fast as he could. He was aware of the danger in this, but he considered that risk acceptable. He almost failed because of it.

The guard, Hagop, was a satyr. That fact alone complicated Casey's task, since alteration of his bone structure was necessary when he impersonated one of them, whereas with a skinny it was not. The differences could be camouflaged quite superficially and still be passable.

Hagop was also fat. Satyrs were fat in about the same proportions humans were, and when they were fat they were also inclined to be lazy. Hagop too was lazy, but he was not lazy enough to omit a visual check of the screen when the buzzer rang. The buzzer was his signal to admit someone who had been outside.

Without putting down his magazine, and hardly without taking his eyes off the centerfold he had been examining

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with such prurience at the time the bell rang, he flipped the switch on the outside screen pickup.

A face, a skinny face, appeared instantly. He recognized it as the skinny maintenance engineer, Flacco. Flacco was always prowling around the station complaining of something or other, usually the slovenliness of the satyr guards. Hagop did not like him very much.

Hagop noticed something peculiar, and commented. "Why are you not wearing a suit, Flacco?"

"It is unnecessary to go through the effort for a few moments outside, and it is too cumbersome for delicate work. Open the airlock and let me in."

"How did you get out to begin with?"

"I went through the other lock—just before you came on duty. Now open up."

"How long did you say you had been out there?"

"I did not say. You are beginning to irritate me, kaii. Cycle this airlock at once."

Hagop's hand drifted to the control board, where the light was blinking red over the airlock switch. He threw the switch to the first position and the light went out. Flacco's image disappeared from the screen.

Hagop did not know why he continued to watch. It wasn't his custom, and certainly he had more entertaining things to do. Nevertheless he pressed another button, and activated a camera in the lock itself.

Flacco stood with his back to it while swirls of dust blown in from outside curled around him. Had he been wearing a suit, the chamber would simply have been evacuated, then refilled with station air. Since he had not been, the other cycle had to be used and the air was flushed to the outside, replaced from storage tanks. That cycle was considerably longer.

As Hagop watched, something happened to Flacco—something frightening. Flacco's color was fading. Hagop activated an intercom. "Flacco—what is wrong? Are you sick?"

"No," came the answer. "I am fine. Open the inner hatch."

"No! I do not want you in here with me until I know it is safe. How do I know what you might be bringing in with you?"

"I told you, I am all right. Let me in."

Hagop did not reply. He shut off that intercom station and activated another, to the station commander, a severe looking skinny named Pudlik.

Pudlik answered, a somewhat annoyed tone in his voice. "What is the trouble, Hagop?"

"Flacco is in the airlock. He went outside without a suit. Now, he looks peculiar, and I think he is ill. I have refused to admit him until I am certain."

"How does he look 'peculiar'?"

"He is changing color."

"I shall be there momentarily. You have done well, Hagop." Pudlik did not ordinarily like satyrs very much either, though he found them to be excellent lackeys. They followed orders to the letter, and, properly handled, displayed a servility never found among guards of his own race. And Hagop had been quite correct to be alarmed over the color change. A slight pallor was a

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symptom of many diseases to which his people were subject.

Pudlik arrived at the guard station in less than a minute. He found Hagop staring into the video display. He could see Flacco's mouth moving, but since the sound was off he could not hear his words.

"He looks normal enough to me. Turn on the sound, Hagop."

Hagop did as he was told, protesting that Flacco had changed back during the interim.

"Flacco; what were you doing outside without a suit?"

"Adjusting the palagometer fingers."

"The what?"

"It's technical. You wouldn't understand. It is very delicate work, and they are awkwardly located."

Pudlik did not have sufficient acquaintance with the station's hardware to tell if that was true, but Hagop had been right about one thing: Flacco did not seem the same. Pudlik decided he did not like the voice. He devised a further test. "Flacco, who am I?"

"You are the commander."

"Yes—but what is my name?"

"I have always called you 'The Commander.' "

"I see; and who is this?" He motioned to Hagop, who came over and stared into the camera.

"He is the monitor."

"What is his name?"

"Who pays attention to kaii names?"

Inwardly, Pudlik silently agreed. What disturbed him was Flacco's failure to remember his own name. "Move to the far wall, Flacco."

The image shifted.

"Why are you not wearing shoes, Flacco?"

"They interfere with climbing. I left them inside."

"Where?"

"In my quarters."

Pudlik flipped the switch, turning his microphone off. He did not know why, but he wanted to know. "Hagop."

"Yes, Commander?"

"Go to Flacco's quarters. Get his shoes."

"Yes, Sir." Hagop waddled off."

While he was gone, Pudlik watched the screen. Flacco stood woodenly in one corner, the camera focused on him. Pudlik had to admit he did not look the least bit pale.

"Commander!"

Pudlik turned. Hagop was approaching at a dead run, closely followed by —Flacco!

"Commander—if this is Flacco, who is that outside?"

"I do not know, but I intend to find out."

"I shall send for help, Commander." Hagop picked up his communicator.

"No! We will handle this ourselves. Whoever it is is trapped in the airlock. He cannot escape. I will not have those idiots at headquarters sopping up the credit for his capture."

Hagop put the communicator down. He did not like that idea. It was contrary to standing orders. Under those orders, *anything* out of the ordinary was to be reported before local action was taken. He started to protest, then changed his mind. It was not *his* responsibility, and he would not be blamed if he merely followed orders from the commander.

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"Summon the station physician, Hagop."

"Yes, sir." Hagop punched a three digit number into his communicator, then spoke briefly into its mouthpiece.

Presently another skinny appeared. This one was aged, and looked harried—an impression cultivated by those in his calling of whatever race. "What is wrong, Commander?"

"Look at the screen, Doctor; then *you* tell *me*."

The doctor did. "Why, it looks like *him*," he said, pointing to Flacco. "Your twin?"

"I have no tiwn," Flacco replied.

"Then, who is it?"

"We have no idea, Doctor. He claims to be Flacco, but as you can see, Flacco is here. And he does not know my name. He obviously intended to enter the station and impersonate Flacco."

"Then he must be one of the prisoners."

"We can check that easily enough. We have photographs of all of them. Attend to it, Hagop."

Hagop sat down in front of the control panel and began punching buttons. First, he tied the computer into the video camera and extracted a series of still images, which he then commanded the computer to match, if it could. It couldn't. "Not a prisoner, Commander," he said.

"Try it against the station personnel records, then."

Fingers flew across the keyboard. The computer hiccupped. "A match, Commander--Flacco."

"Incredible—an impersonation good enough to fool the computer. This *would* have been a dangerous situation. I commend you on your vigilance, Hagop."

Hagop experienced the satyr equivalent of a blush, but he did not reply. He hoped the commander would remember to make the commendation official and enter it on his records.

But Pudlik, it seemed, was preoccupied with his problem. He turned to the doctor. "What do you have here at the station that will put him out, Doctor?"

"Any number of things, but under the circumstances, I would recommend an anesthetic gas. But I would also recommend he not be brought inside. He may carry disease."

"Is that what you think this is? Do you know of any diseases which produce symptoms like that?"

"Well, no. But—"

"Then it is not a medical decision, is it?"

"No, sir."

"Prepare the anesthetic, then, Flacco."

"Yes, Commander."

"The Doctor will require your assistance to administer the gas."

"Yes, sir."

Kah-Si-Omah, He Who Waits, waited once again. He was perplexed, but without panic. He knew that his impersonation was suspect, but he did not yet know how he had been detected. He had not, of course, been able to see into the control room, though he knew those in it could see him.

At first he had considered disabling the camera and depriving them of this advantage, but decided for two reasons not to do it. First, it would have the effect of confirming their suspicions, and he could not risk that while there

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was still a chance he could bluff his way through. Secondly, it was up too high on the wall, far beyond the normal reach of the creature he impersonated; and while he could easily have altered his arm to reach it, that too, would be noticed.

So he waited patiently for them to make a move. He was not uncomfortable in the airlock, merely immobilized. He knew that sooner or later the station people would take some action to examine him closer. They would probably come out the other lock in sufficient numbers to overcome him, then open the outer door to this one. He was ready if that happened. Although unarmed, he had traveled everywhere throughout the centuries he had lived, and studied many things. He was familiar with, and proficient in, every form of unarmed combat human beings had developed; and he had the anatomical skill to apply many of those same techniques to the skinny and satyr bodily forms. He had no doubt that he could at least escape, if it were impossible to defeat the lot of them.

But that would not get him inside the station, and he *must* get in. So, despite the perils which would attend surrender, this is what he had resolved to do.

Abruptly, his train of thought was rudely derailed. Something was happening. There was a faint hissing noise coming from the intake ports, and he felt strangely lightheaded. Gas!

In a normal individual the thought of gas would have consumed the last few moments of consciousness in contemplation of terror. Kah-Si-Omah was beyond that. In his time he had faced such dangers often. He Who Waits did not panic. He Who Waits simply adapted, and waited some more. Thus it had been, on those occasions when he had been buried alive in cave-ins, or choked by poison gases in fires, or trapped in sinking ships.

With the bodily capabilities those mysterious creatures had given him so many millenia ago, he could not be greatly inconvenienced by such prosaic things as anesthetic gases. Almost unconsciously he willed his respiration to cease, so that he would inspire no more of it until he was ready. For long moments his body leached oxygen from non-essential tissues and dumped it back into his bloodstream, where it was immediately shunted first to his brain and then to his heart.

In those precious seconds, his mind cleared; his thoughts became sharp and precise. Other commands went out, across neural pathways no other creature in all the universe had. Some of these went to Casey's liver. There, on molecule-sized samples of the anesthetic the cells poured out hundreds of hastily fashioned enzymes. When at last one of them fit the molecule better than the molecule fit the hemoglobin in Casey's blood the liver turned its massive chemical strength entirely on that enzyme's production.

As soon as this process had begun it dumped the enzymes into his circulatory system. Changes had occurred there, too. Valves other human beings lacked opened and closed, and soon his heart was pumping the enzyme-laden blood through his pulmonary artery. From there it seeped into the tiny capillaries of the alveoli themselves.

Only then did Casey's chest resume

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its regular rise and fall, secure in the knowledge that the gas molecules could not attach, and that the vital oxygen still could. The gas would still have some effect, because the volume of space it occupied could not be utilized to accommodate oxygen; but the effect was no more onerous than operating at a fairly high altitude would be. The body could stand it easily even if it could not increase blood pressure to compensate, and Casey's system could.

He Who Waits was ready. During the process he had carefully feigned the symptoms of unconsciousness. First he had wobbled, then slumped, and finally collapsed, motionless on the airlock floor.

Suddenly there was a tremendous whooshing sound. High speed pumps began evacuating the chamber and through outlets in the walls compressed air blasted into it.

After about thirty seconds the sound stopped, and the inner lock opened. Arms grasped Casey's body and dragged it out of the lock.

He had his eyes closed, of course, but he listened carefully to every word they said. He recognized the voice of the Commander.

"How long will this keep him under, Doctor?"

"Not long."

"Hagop?"

"Yes, sir?"

"Fetch rope; tie him up before he regains consciousness."

"Not necessary, Commander," said the doctor. "I have prepared an injection."

"What is in it, Doctor?" Pudlik wanted to know.

"Essentially the same thing he would be getting if he were outside, Commander, except in this case it has been refined and will therefore affect him much faster. Uh—it is my own private project. I have been working on it since I came here. I think it might be useful to the military, and I intend to offer it to the government when testing is complete."

"Yes," said Pudlik. "I can appreciate its usefulness—if it works. Hadn't you better get on with the testing?"

"At once, Commander."

This discourse had been of immense value to Casey. It was a stroke of extreme good fortune that the doctor had picked that particular substance. His body had been neutralizing the toxin since he had arrived, so the mechanism was already extant. It had not, however, done it with such a massive dosage as an injection would represent; therefore, he would slow the process down.

When the doctor slid the needle into his vein Casey promptly ordered his body to close that vessel off at the nearest convenient branch. This maneuver resulted in enough distension of that vessel to alarm the doctor, who terminated the injection without administering the entire dose.

When he withdrew the needle he explained it to the Commander. "Be careful. I couldn't give him all of it without injuring the vessel, but he'll be unable to move for several hours, at least."

"Won't it kill him by then?"

"No. The vehicle I'm using will release it slowly enough so that he still has enough muscle function to stay alive, but not so slowly that his body

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can eliminate it within that time period."

"When can I start the interrogation?"

"As soon as you like."

"Then," said Pudlik, looking at Hagop, "I will begin now. Take him to the Guard's Lounge. I will use that."

Hagop gulped. Now why didn't he use some other facility? Hagop spent almost all his off-duty time in the lounge, and he would be finished with his watch in twenty minutes.

Nevertheless, good soldier that he was, he slung the comatose skinny over his shoulders, carried him to the lounge, and laid him out on the cometball table. Several troopers who were playing the billiard-like game at the time protested—until they saw the commander. The commander immediately shooed everybody out, closed the door, and ordered Hagop to stand guard—outside.

"Now then," he said to the supine figure as soon as Casey opened his eyes. "You *will* answer my questions—truthfully. If you do not answer, or if you lie to me, I will have the doctor increase the dosage until you must fight for every breath. Do you understand?"

"Yes." Casey not only understood; he agreed that cooperation was an excellent idea. He had always believed in keeping his plans flexible; and even though on this occasion the enemy had caught him, or thought they had, he was even now busy integrating this development into his strategy.

"Good. Who are you?"

"I am Kah-Si-Omah."

"That is your name?"

"Yes."

"How did you get here?"

"I came through the transmatter, like all the other prisoners, from the Imperial City."

"You lie. The computer could not match your image."

"It had a different image."

"Where did you come from?"

"From Earth."

"Where is Earth? I have not heard of it."

"I do not know how to get there from here."

"But you know how to get from Earth to the Imperial City?"

"Yes."

"I see." Wheels were turning rapidly in Pudlik's mind. He had indeed stumbled upon something sinister, something that obviously posed a grave danger to the Imperium. He saw an advantage in that for himself: a way to realize an ambition, a way to climb out of a dead-end job and get back into the mainstream of the service. Rank and fortune would come easily to persons whom the Imperium thought resourceful. Pudlik would demonstrate how resourceful he could be.

"Why did you come here?"

"To free the prisoners."

"All of them?"

"Yes."

"Why?"

"So that they might join the government in exile."

"There is no such thing."

"Very well. I will accommodate you. I will agree; there is no such thing."

Pudlik did not like that reply. He had prepared himself to interrogate a stubborn captive, a deceitful captive, a silent captive. He was not quite certain how to handle one who seemed quite willing to tell him anything he wanted to know.

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That would require cunning, and though Pudlik did not doubt he possessed that faculty, he resolved to go slowly. "Where is this government in exile located?"

"On the planet Campbell."

"And, I suppose you do not know where Campbell is either?"

"That is correct."

"But you went from Campbell to Imperial City?"

"No. I went from Ithaca, to Wolfingham, to Gringar, to Imperial City."

"Those names are strange to me—except Gringar. Gringar is an Imperial Colony, is it not?"

"Yes."

"It is, in fact, a probationary colony?"

"If you say so."

That fact bothered Pudlik a great deal. Probationary colonists were permitted only limited travel, especially to the imperial planet. It was a dumping ground for all kinds of misfits, including people who displayed the milder forms of political dissent. Security at the transmatter stations was almost as tight as here on Maygarth. If this person had transported from Gringar to Imperial City he must have done so with the help of station personnel. And that meant there had to be a vast and powerful conspiracy against the empire.

Pudlik decided it could not hurt to ask the prisoner, so he did. "What does this 'government in exile' expect to do with the prisoners you are trying to free?"

"It intends to overthrow the Imperium."

"I see. Is that not a formidable task?"

"Yes. It is very formidable."

"Yet they have undertaken it?"

"Yes."

"Do you know how big the Imperium is?"

"No. How big is it?"

"It occupies three-hundred sixteen planetary systems, populated by fourteen separate races, of which we are the most important. Altogether there are approximately 1.7 trillion individuals. That is many, is it not?"

"Yes."

"How many planetary systems do the exiles have?"

"I do not know."

"How many races? How many individuals?"

"I do not know."

"Are there as many as in the imperium?"

"I do not know."

"Are we the dominant race among the exiles?"

"We?"

"Yes, our kind. Surely, we are."

"No."

"Who is?"

"Human beings are. They are called 'the people.' "

"What is a human being?"

"I am a human being."

"Then, we *are* dominant."

"No. I said, 'I am a human being'; you are not. I am a shaman of the people. In the shamen reposes the power of 'the people.' "

Pudlik did not understand the significance of that answer until it was too late.

With incredible speed, speed so blinding that Pudlik's eyes caught only a blur of it, a long tentacle which had been concealed beneath the prisoner's body lashed out. It whipped around

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Pudlik, binding his arms firmly to his sides. On the end it was flattened, like a living ribbon, and it was this tip that suddenly covered his mouth. The scream which had been welling up in Pudlik's throat since the instant his eyes detected the blur, died unborn.

The captive rose to a seated position on the table. He reached out with his left arm and drew Pudlik near. "Do not struggle," said the former captive. "It is useless."

Casey extended his right arm. The arm had changed subtly. One of its fingers had grown a horny point. Behind the point it was curiously swollen. He laid the point on Pudlik's arm, then pushed. The point broke through the commander's skin and entered a vein. The swelling behind the point rapidly subsided.

"I trust that the doctor was careful with the dosage, Commander. As you will soon see, I saved the drug for you. To it I have added a little embellishment of my own. In a little while you will become too weak to move. You will still be able to speak, though I caution you to do so softly. If you try to give alarm you will go to sleep, and you will never wake again. The doctor could never identify the substance I added in time to save your life." That last threat was not true, but it was necessary that Pudlik think it was. Casey's carefully contrived answers to the commander's questions had all been designed to reinforce his credibility.

Casey felt Pudlik go limp, and relaxed his grip somewhat. Pudlik slithered to the floor, sprawling out like a limp rag.

Casey picked him up and placed him on the table, after which he removed Pudlik's shoes from his feet and the harness affair that all the guards wore around the upper torso.

Pudlik lay there on the table, unable to move and afraid to speak, as Casey donned the articles he had taken off the commander. As he did so, he explained why he was doing it.

"I am about to take your place, Commander. When I have finished with what I have to do I will be you, complete to the pattern of blood vessels on your retina and the configuration of your vocal cords. I will look like you, and I will sound like you. To your people, here at the station and at imperial headquarters, I will be you."

Pudlik glared up at Casey, but he did not respond. Instead, he watched in horror at the spike that was growing out of Casey's forehead.

The spike resembled a horn but as it grew it became thinner and thinner. On its tip another horny scale was forming. Gradually, over the course of several minutes it had reached a length of over two feet, and dangled down across Casey's chest.

Then, grasping Pudlik in both arms, Casey rolled him over. He took the new appendage in one hand and jammed its tip deep into the back of Pudlik's neck, while with his other hand, he covered the commander's mouth. "I am about to tap into your central nervous system, Commander. Through the tap I will learn enough about your body to duplicate all the necessary systems. When I am finished there will be nothing about its structure that I will not know, and my impersonation will become undetectable."

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That last statement was also not quite true. It would not be completely undetectable. No impersonation ever was. There still remained in Casey's body the basic human structures he was born with, but the cosmetic changes would be complete. These changes would conform his body to Pudlik's pattern in every way his comrades would be likely to check.

The procedure was not a lengthy one, and Casey was, of course, quite skilled at it. He had had millenia to practice, and in this interval he had not confined his experiments to his own species. There had been occasions, in the past, when he had undertaken to mimic animals.

When it was over he withdrew the probe. It began to recede, to be reabsorbed into his body just as the long tentacle with which he had bound Pudlik had been absorbed. He rolled the commander over on his back, even as he almost unconsciously began making the necessary alterations.

"There, you see, Commander, how easy it is for the shamen. Watch my features change, become your features. See me become you, as I might become any person in the Imperium."

Pudlik did watch. He watched with horror. Only when the change was complete did he find the courage to speak. "W-what now?"

"Now? Now, Commander you will go to sleep, and I will call Hagop. Hagop will rush in here and see two of us. I will tell him that I watched your form change with my own eyes, and he will believe me, because he watched the doctor inject the poison into my arm with *his* own eyes. He will examine my arm and find no puncture. Then he will examine your arm, which, as you know, contains one. Is there anything else you would like to know before you go to sleep?"

Pudlik hesitated. His thoughts were a mass of confusion. He could plainly see that this creature had completely destroyed him. Whether he lived through this or not Pudlik would himself become an outcast as soon as his superiors learned what had happened. Still, he was curious about this strange "shaman." This creature of such sure and effortless power, this superbeing before whom all defenses seemed as flimsy as soap bubbles. "What do you want? What will you do to the Imperium?"

"What will *we* do, Commander? We will destroy it, utterly; we will obliterate its very memory."

"Why?"

"Because the imperium is an evil thing. Because it is dominated by venal creatures, such as yourself. Because it is oppressive and corrupt. But worst of all, it is inept. It cannot prevail over even one shaman, therefore it is too weak to protect its citizens from the really powerful forces in this galaxy, forces greater even than the shamen."

Pudlik did a very human thing: he gulped.

Casey noted this; he had called the confluence of such emotions among sentients a universal truth. And it was. Truth, anywhere in the universe, seemed equivalent to the consensus of sapient emotion among the creatures which inhabited it. Casey believed this, both as a man and as a shaman. He knew that

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if he were to succeed, the entire known universe must also believe.

"There are," he told Pudlik, "beings as superior to me as I am to you. These beings created me, gave me the powers you have seen me use and many more besides. If I tell you that I have already lived many times as long as the recorded history of my race you must believe that, because it is true. Now sleep."

He placed his hand on Pudlik's arm, just above the puncture. There he had implanted, protected by a crystaline coating, a tiny quantity of one of the skinny endorphins, which his own body had synthesized. The pressure broke the fragile coating and it poured into the commander's bloodstream. A few seconds later, the lights went out for Pudlik.

Kevin C. O'Meara was coming home. The skimmer which brought him was driven by the Commissioner of Alien Affairs himself; no small honor when Carmody's personality was taken into consideration.

Carmody was not a very talkative person, and Casey himself seemed disinclined. He napped throughout the two-hour journey, though whether this was real or illusory, Carmody couldn't tell. Certainly if any man deserved a rest, it was Casey. He'd done a yeoman's job.

Still, Carmody was not entirely pleased with the way things had come out. He did not entirely agree that human destiny should depend on anything so fragile as a legend, yet that was the position into which Casey's actions had plunged man.

And it did not look very workable. After all, some of the persons who must necessarily believe in it were hard-headed scientists; scientists of a technological level far beyond anything that humanity had reached or was likely to reach within Carmody's lifetime, even with help.

The O'Meara homestead had appeared on the western horizon, looking so peaceful and so solitary that Carmody could not make himself believe its owner was the man who had probably determined humanity's course for the next thousand years.

He began to cut the power and the skimmer lost lift, gliding smoothly to a landing in the front yard. Kim and the two children, this time conventionally dressed, emerged from the house and ran to greet Casey.

Casey, by this time quite alert, sprang out like a gazelle and hugged them all, in turn.

Carmody waited a decent interval, then motioned to Kim.

She approached the driver's window, looking bright-eyed and relieved.

"You see," he told her, "I brought him back, good as new, just as I said I would. And he got the job done for us just as he said he would."

"I guess it was a little selfish of me to try to keep him from going," she replied. "But you understand, I'm sure, how much the time we have together means to both of us."

Carmody nodded. The subtlety of that remark was not lost on him, and therefore when he received the obligatory invitation to stay for dinner he gave the obligatory reply. "No, thanks just the same, Kim. I have urgent government business I must return to."

They waved goodbye to him as the

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skimmer rose, and watched it drift off out of sight. After it had become an insignificant speck, and after the children had run off to diversions of their own, Kim took Casey into the house and poured two cups of mescof.

For a while they sat at the kitchen table sipping quietly, each lost in his own thoughts.

To Kim, Casey seemed strangely troubled; moodier than she ever remembered seeing him. It was reminiscent of their first days together.

Finally, just as she had done then, she broke the silence and asked, "What's wrong, Casey?"

Casey put his cup down, sighed, and looked into her eyes. "Maybe nothing, Kim. But, it occurs to me that I am missing one power my creators might easily have given me. One which would have made life incomparably simpler."

"What power is that, Casey?"

"Prescience. If I could look ahead as I look into the past I would know whether I had done the right thing. But as it is I can only judge the future by what has gone before. And nothing quite like this has ever happened before; at least, not on the scale I have just attempted."

"I haven't pried, Casey. I know that when you are ready, you will explain what you have done; at least, as much of it as I can understand."

"There is no mystery in my actions, Kim. I have once again become a shaman, and I have done what medicine men have always done. It is a calling far older than I, perhaps as old as man himself."

"I don't understand."

Casey explained. He told her all: how he had visited the captive aliens, walking up on them out of the desert like a spectre. Overwhelming their reason with displays of powers which, even to astute scientists, could only be accomplished by magic means. And he told her how he had labored to build up that mystique; to create an image of a super-being, immune from the natural laws of the universe which each of them had previously believed in. He had done, before their very eyes, consistently and without apparent effort, things which they *knew* to be impossible.

And then had come the threat, implicit in the knowledge that somewhere on the outer marches of the known universe were other creatures to whom this same super-being was as a microbe. Beings of awesome power, including the power to create super-beings such as he.

By the time he finished his narrative the sun had set, and the children hovered near the darkened doorway, hesitant to interrupt what to them was serious and incomprehensible adult talk.

"So, you see, Kim, I have told a great lie, and because of that lie man must now become a keeper for his neighbors of the worlds nearby. And the danger in that is that we have, in our midst, many aliens who know the truth about us, together with others who do not know and who are simply unfortunate victims of the times.

"They are now true exiles. None of them must ever be allowed contact with their homeworlds again. Their later generations, yes, but not these. Even now, Carmody's people are carting them off to a colony world far down the spiral arm, where they will endure great hard-

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ships and where many of them will die. Their maintenance will cost our people most of its surplus wealth for the next two or three generations; but it must be done, and all to support a lie."

"We have the transmatter now, don't we, Casey. That should help."

"Yes. We have that, but even that was obtained by deceit. We told these alien scientists they could go home, and they told us how the system worked. Then we reneged; we sent them on to the colony with all the rest, after smashing any transmatter station they might have used to escape. It is not a deed I am proud to have helped accomplish."

"Don't blame yourself, Casey. It was necessary. I understand that. So does everyone else who knows. Casey, you mentioned prescience a while ago. You said you wished you had it. But maybe prescience fits in here someplace after all."

"What do you mean?"

"I mean, this may all have been foreseen, not by you, but by your creators. You always said you felt you existed for a reason; that without a purpose in mind they would never have made you what you are. Can you be certain that you have not just fulfilled that purpose in doing what you did?"

Casey did not answer her. But he took the point well, found comfort in it. He could easily envision such a thing: the beings who made him, to him omniscient, looking forward into time and seeing the menace the Imperium would become to the sapient races with which it shared its space.

And it was not unimaginable that even then in the dimness of his remote past they would choose to alter the course. He found nothing incomprehensible about that; nothing that prevented that from becoming his firm belief.

And how, he wondered, would they do that; how would they manipulate races of beings which to them were so primitive as to be incapable of the exercise of true reason?

He found the answer to that question in himself, in what he was, in what he always had been. And on the cosmic scale he could detect no difference in what he was doing at the insistence of his makers, and what he had done for most of his enormous lifespan. He had chanted, and he had rattled bones. He had donned hideous masks and invoked divine powers. He had at once promised mercy and uttered veiled threats. He had used obscure words and innuendoes and sleight of hand. He had worked magic which was not magic, but merely the manipulation of natural things by natural laws dimly understood even by he who used them.

The effect was the same as it always was wherever the ignorant are confronted by the unfathomable; wherever rumor rules instead of fact; wherever logic is driven from the mind and panic is substituted.

Every shaman knows what happens next: there is recoil from the unknown, retreat into the familiar and the safe, retrenchment from doubt; and hovering over it all, a massive, immobile, and wholly enveloping impression of impotence in the face of that which is almighty.

This, Casey knew. As a shaman of the people it had been his obligation to know. He had performed that obligation

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faithfully, and had done what the shaman must do.

Within the imperium there would be bewilderment, while frantic beings pondered what had occurred on the fringes of their empire; wondered what had sealed them off from themselves, both physically and within their own minds. The imperium had been large. It had cloaked itself with the aura of invincibility. It had expanded inexorably, feeding itself suns. It had seemed too large, too momentous ever to stop. Now it had, and like a sun gone nova, squandering the energy its collapse had created, it would soon find itself a small and insignificant thing.

When a star dies, when an empire dies, darkness comes to both. Casey had seen it many times before. In a few short generations these imperials would be barbarians again, warring, marching, pillaging and burning. There would be those among them who saw further and learned more; who would use their wisdom wisely, and dole it out sparingly in riddles and with mysticism to the beat of the tom-tom and the rattle of bones.

He Who Waits was *not* alone. ■

ON GAMING

(continued from page 95)

with a fierce, aggressive nature quite opposite to that of the puppeteers).

While Earth did fight a series of four bloody wars with the kzinti (which ended with a human victory and a truce), peace now reigns over Known Space—an area of over 80 light years in diameter, with more than 10,000 stars. That's enough territory to adventure in for many years, but the focus of the game is on the mysterious life-forms and engineering of the Ringworld.

Ringworld includes an enormous wealth of information culled from Niven's novels. This is presented in four books and two reference sheets with charts and tables. You also get a sheet of cut-out characters, and five dice.

The 48-page *Gamemaster Book* contains essays for the referee about the structure and intent of Ringworld, a scenario generator, data on technology (which varies radically from one section of Ringworld to the next), plus a short glossary and introductory scenario called *The Journey of the Catseye*.

The 60-page *Explorer Book* has rules to create a human or alien character, add skills, and it outlines the mechanics of game play. There are also details on each species and their major worlds and history, plus a lengthy glossary of "Known Space."

The 36-page *Technology Book* outlines tools, weapons, etc. explorers will need in their adventures on the Ringworld. Like the other books in the game, this one is well-illustrated and interesting to read.

The 44-page *Creatures Book* is great to browse through, even if you're not going to play the game. Many wonderful and incredible life-forms that inhabit the Ringworld are detailed in this book, including grass giants, city builders, muck ogres, ghouls, and vampires, among others.

All in all, Chaosium's translation of Niven's *Ringworld* series into a role-playing game has a lot to recommend it. If you enjoy the books, you'll enjoy the game. ■

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a calendar of analog upcoming events

27-28 October
DANCON (Danish SF convention) at Valby Medborgerhus Valgardsvej 2. Info: Science Fiction Cirklen, Strandvejen 89, DK 4880 Nysted, Denmark.

2-4 November
CONCLAVE IX (Michigan SF conference) at Plymouth Hilton, Plymouth Mich. Guest of Honor—Spider Robinson, Fan Guest of Honor—Buck Coulson, Music Guest of Honor—Juanita Coulson. Registration—$15. Info: Waldo & Magic Inc., Box 2915, Ann Arbor MI 48106.

2-4 November
CONCENTRIC 84 (Missouri SF conference) at Tiger hotel, Columbia, Mo. Guest of Honor—Paul O. Williams, Fan Guest of Honor—Rob Chilson. Registration—$15 at the door. Info: Concentric 84, Box 7514, Columbia MO 65205.

9-11 November
TUCSON XI (southern Arizona SF conference) at Executive Inn, Tucson, Ariz. Guest of Honor—John Varley, Fan Guests of Honor—Bruce and Kim Farr. Registration—$20 at the door. Info: TUCSON, Box 26822, Tucson AZ 85726.

23-25 November
LOSCON 11 (LA area SF conference) at Pasadena Hilton, Pasadena, Calif. Guest of Honor—Curt Siodmak, Fan Guest of Honor—Forrest J. Ackerman, LASFS Guest of Honor—Bill Warren. Registration—$15 to 8 September, $17.50 to 22 November, $20 at the door. Info: Loscon 11, c/o LASFS, 11513 Burbank Boulevard, North Hollywood CA 91601.

10-14 December
DECUS (Digital Equipment Computer Users Society) semiannual national meeting at Anaheim Convention Center, Anaheim, Calif. Info: DECUS U.S. Chapter, 249 Northboro Road (BP02), Marlboro, MA 01752.

22-26 August 1985
AUSSIECON II (43rd World Science Fiction Convention) at Southern Cross Hotel, Melbourne, Victoria, Australia. Guest of Honor—Gene Wolfe, Fan Guest of Honor—Ted White Registration—A$30 until 31 December 1984 (supporting); A$50 until 31 December 1984 (attending). This is the SF universe's annual get-together. Professionals and readers from all over the world will be in attendance. Talks, panels, films, fancy dress competition, the works. Join now and get to nominate and vote for the Hugo awards and the John W. Campbell Award for Best New Writer. Info: Aussiecon Two, GPO Box 2253U, Melbourne VIC 3001, Australia (use airmail); Fred Patten, 11863 West Jefferson Blvd. #1, Culver city CA 90230 (membership info); jan howard finder, Box 428, Latham NY 12100.

30 August-2 September 1985
NASFiC 1985 (North American SF Convention, officially The First Occasional Lone Star SF Convention & Chili Cook-off) at the Hyatt Regency Austin and Palmer Auditorium, Austin, Texas. Guest of Honor—Jack Vance, Artist Guest of Honor—Richard Powers, Fan Guest of Honor—Joanne Burger, TM—Chad Oliver. Registration—attending $25 until 30 June 1984, supporting—$15. Info: NASFiC, Box 9612, Austin TX 78766.

—Anthony Lewis

Items for the Calendar should be sent to the Editorial Offices six months in advance of the event.

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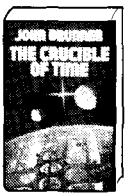

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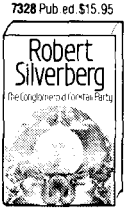

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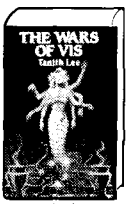

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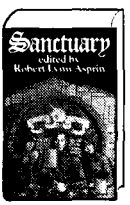

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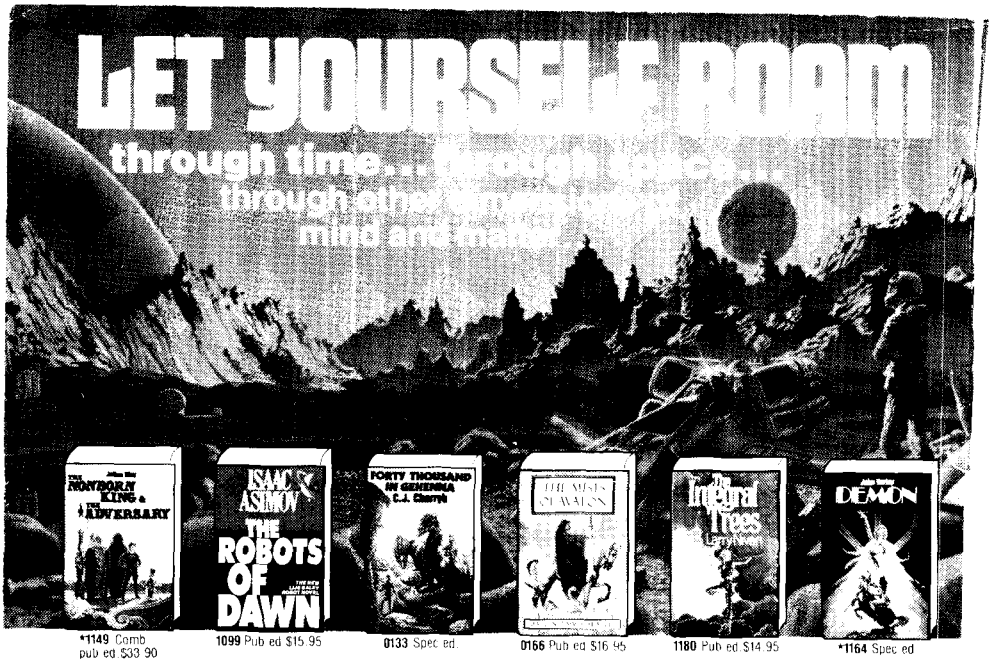

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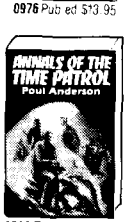

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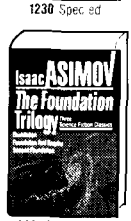

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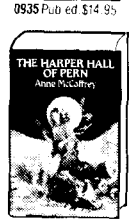

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